

AD-A156 571

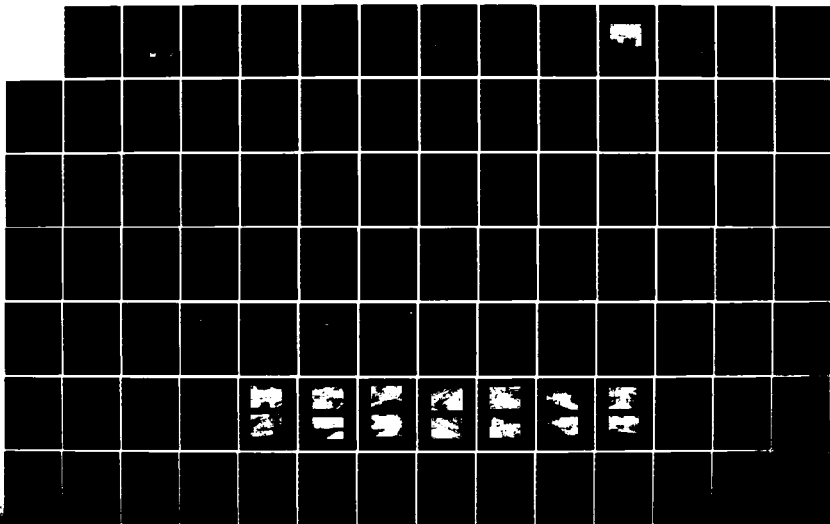
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS  
UNION LAKE DAM (NH 00.) (U) CORPS OF ENGINEERS WALTHAM  
MA NEW ENGLAND DIV AUG 78

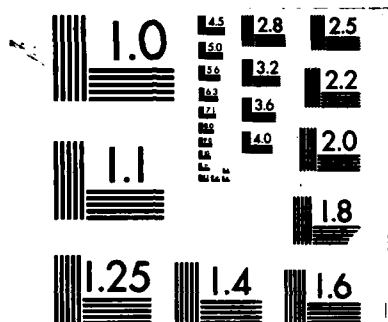
1/1

UNCLASSIFIED

F/G 13/13

NL





MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

AD-A156 571

PISCATAQUA RIVER BASIN  
BARRINGTON, NEW HAMPSHIRE

UNION LAKE DAM  
NH 00232

STATE NO 15.02

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM

DTIC FILE COPY



DTIC  
ELECTE  
JUL 09 1985  
S D  
G

DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
WALTHAM, MASS. 02154

AUGUST 1978

DTIC STATEMENT A  
Approved for public release;  
Distribution Unlimited

85 06 14 129

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NH 00232	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Union Lake Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE August 1978
		13. NUMBER OF PAGES 62
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Piscataqua River Basin Barrington, New Hampshire Bellamy River		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam is 17 ft. high and 433 ft. long. It is an earth embankment placed be- tween vertical dry masonry walls. The dam is in poor condition with a few major concerns. A major breach at maximum pool would probably result in the loss of less than 10 lives and appreciable property.		



DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
424 TRAPELO ROAD  
WALTHAM, MASSACHUSETTS 02154

REPLY TO  
ATTENTION OF:

NEDED

JAN 22 1979

Honorable Hugh J. Gallen  
Governor of the State of New Hampshire  
State House  
Concord, New Hampshire 03301

Dear Governor Gallen:

I am forwarding to you a copy of the Union Lake Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

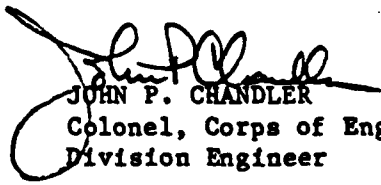
A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, Mrs. Gail P. Chase, Prescott Road, Epping, New Hampshire 03042.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely yours,

Incl  
As stated

  
JOHN P. CHANDLER  
Colonel, Corps of Engineers  
Division Engineer

**UNION LAKE DAM**

NH 00232

**PISCATAQUA RIVER BASIN  
BARRINGTON, NEW HAMPSHIRE**

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A/1	

**PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM**



NATIONAL DAM INSPECTION REPORT  
PHASE I INSPECTION REPORT

Identification No.: NH00232  
Name of Dam: Union Lake Dam  
Town: Barrington  
County and State: Strafford County, New Hampshire  
Stream: Bellamy River  
Date of Inspection: 13 June 1978

BRIEF ASSESSMENT

Union Lake Dam is 17 feet high, 25 to 36 feet wide at the crest, and 433 feet long. It is an earthen embankment placed between vertical dry masonry walls, spans the headwaters of the Bellamy River, and is located in east central New Hampshire. A small wooden shed covers the lifting mechanism for the low-level sluice gate. This shed also spans a 12-foot wide stoplog spillway. The stoplogs have been permanently removed to allow for a larger spillway capacity. Union Lake is almost 2 miles in length, has a surface area of 405 acres, and has a maximum storage capacity of 3900 acre-feet. The lake is used presently for recreational purposes.

The dam is in poor condition. Major concerns with regard to the overall long-term safety are: (1) the overtopping potential because of the inadequate spillway; (2) seepage near the base of the downstream dry masonry wall on both sides of the spillway; (3) the significant number of large tree stumps and the radiating roots on the crest of the dam; (4) lack of erosion protection on the upstream face of the dam between the gatehouse and the north abutment; (5) trespassing on the upstream slope of the dam, including use as a swimming beach, boat launching, and boat mooring area; (6) construction on the downstream slope of the dam, including an expanded house trailer (mobile home) and an abandoned privy; and (7) possible seepage near the south abutment.

Based on size and hazard classification in accordance with Corps guidelines, the test flood is the Probable Maximum Flood. A PMF outflow of 1850 cfs (463 csm) would overtop the dam by 1.8 feet; therefore the spillway is considered inadequate. The spillway will pass 370 cfs, or 20 percent of the PMF. A major breach at at maximum pool would probably result in the loss of less than 10 lives and appreciable property damage.

The owner, Mrs. Gail P. Chase, should retain the services of a registered professional engineer and implement his consideration of the recommendations given in Section 7.2 within one year after receipt of this Phase I Report. The operating and maintenance measures recommended in Subsection 7.3.b. should be implemented within six months after receipt of this Phase I Report.

*Warren A. Guinan*

Warren A. Guinan  
Project Manager  
N.H. P.E. No. 2339

This Phase I Inspection Report on Union Lake Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.



CHARLES G. TIERSCH, Chairman  
Chief, Foundation and Materials Branch  
Engineering Division

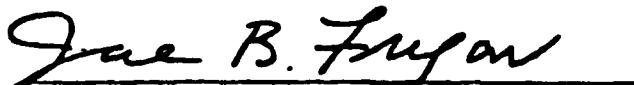


FRED J. RAVENS, Jr., Member  
Chief, Design Branch  
Engineering Division



SAUL COOPER, Member  
Chief, Water Control Branch  
Engineering Division

APPROVAL RECOMMENDED:



JOE B. FRYAR  
Chief, Engineering Division



## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers (OCE), Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

## CONTENTS

Title	Page
LETTER OF TRANSMITTAL.....	i
BRIEF ASSESSMENT.....	ii
REVIEW BOARD PAGE.....	iii
PREFACE.....	iv
CONTENTS.....	v
OVERVIEW PHOTO.....	vi
LOCATION MAP.....	vii

## REPORT

### SECTION

1	PROJECT INFORMATION.....	1
	1.1 General.....	1
	1.2 Description of Project.....	1
	1.3 Pertinent Data.....	3
2	ENGINEERING DATA.....	6
	2.1 Design.....	6
	2.2 Construction.....	6
	2.3 Operation.....	6
	2.4 Evaluation.....	6
3	VISUAL INSPECTION.....	7
	3.1 Findings.....	7
	3.2 Evaluation.....	9
4	OPERATIONAL PROCEDURES.....	11
	4.1 Procedures.....	11
	4.2 Maintenance of Dam.....	11
	4.3 Maintenance of Operating Facilities.....	11
	4.4 Description of Any Warning System in Effect...	11
	4.5 Evaluation.....	11
5	HYDROLOGY AND HYDRAULIC ANALYSIS.....	12
	5.1 Evaluation of Features.....	12
6	STRUCTURAL STABILITY.....	14
	6.1 Evaluation of Structural Stability.....	14
7	ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES....	16
	7.1 Dam Assessment.....	16
	7.2 Recommendations.....	17
	7.3 Remedial Measures.....	17

## APPENDICES

	Designation
CHECK LIST - VISUAL INSPECTION.....	A
INSPECTION REPORTS/SKETCHES.....	B
PHOTOGRAPHS (Figures 2 - 15).....	C
HYDROLOGY/HYDRAULICS.....	D
INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS.....	E

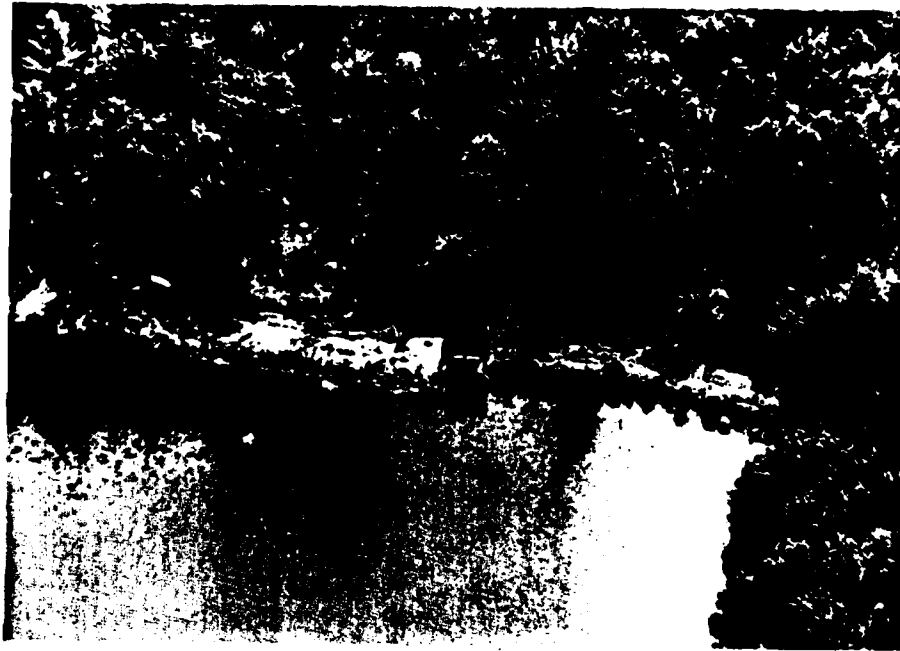


Figure 1 - Overview of Union Lake Dam



NATIONAL DAM INSPECTION PROGRAM  
PHASE I INSPECTION REPORT  
SWAINS POND DAM

SECTION 1  
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Anderson-Nichols & Company, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to Anderson-Nichols under a letter of May 3, 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0329 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the States to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Union Lake, commonly known as Swains Pond, is located in the Town of Barrington, New Hampshire. The pond name was officially changed to Union Lake on February 22, 1927 by the General Court, State of New Hampshire. Union Lake Dam spans the headwaters of the Bellamy River. The Bellamy River flows easterly through Dover, a distance of approximately 11 miles. It then shifts southeasterly and flows a distance of 5 miles before emptying into Great Bay. Union Lake Dam is shown on the U.S.G.S. Quadrangle, Mt. Pawtuckaway, New Hampshire with coordinates approximately at N 43° 11' 18", W 71° 01' 30", Strafford County, New Hampshire. (See Location Map Page vii.)

b. Description of Dam and Appurtenances. Union Lake Dam is an earthen embankment placed between upstream and downstream vertical dry masonry walls. The upstream wall is low as compared with the downstream wall, and it has been partially covered with unprotected random fill. The dam is 433 feet long, 17 feet high and 25 to 36 feet wide at the crest. A small wooden shed covers the lifting mechanism for the low level sluice gate (31" W x 34" H sluice opening). This shed also spans a 12-foot wide stoplog spillway.

c. Size Classification. Intermediate (Hydraulic height - 17 feet; Storage - 3,900 acre-feet) based on storage ( $\geq$  1,000 to  $<$  50,000 acre-feet) as given in OCE Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Significant hazard. A major breach would probably result in the loss of less than 10 lives and appreciable property damage.

e. Ownership. The earliest recorded information concerning Union Lake Dam indicates that it was constructed prior to 1934. Sawyer's Mills, a subsidiary of the American Woolen Company, Inc., is known to have owned and controlled the dam and water rights from 1934 to some unknown date after 1954. The ownership passed through several private owners until Mr. Myron Peabody bought the dam and water rights sometime around 1966. Mr. Peabody continued to control the dam until his death in August of 1977. At this time the ownership passed to his daughter, Mrs. Gail P. Chase, who currently controls Swains Pond Dam.

f. Operator. The current owner and operator of Union Lake Dam is Mrs. Gail P. Chase, Prescott Road, Epping, New Hampshire 03042. Phone (603) 679-5562.

g. Purpose of Dam. The original purpose for the construction of Union Lake Dam was not disclosed. During the years 1935-1952, Sawyer's Mills used Union Lake as upstream storage for use as processing water in their milling operations located in Dover, New Hampshire. Today, Union Lake is used for recreational purposes only.

h. Design and Construction History. Little information was disclosed regarding the original design and construction of Union Lake Dam. From the visual inspection, it is believed that the dam may have been constructed in the late 1800's. This belief was based not only on the masonry construction, but also on several stumps of large trees which had grown on the crest of the dam for at least 55 years.

i. Normal Operating Procedures. No written operational procedures exist for Union Lake Dam. The stoplogs have been permanently removed to allow for a larger spillway capacity;

the gated conduit running through the base of the dam is opened only for repair purposes. Hence, the water level of the lake is determined by natural hydrologic conditions of the drainage basin. The gate can be opened to completely drain the lake, should this become necessary.

### 1.3 Pertinent Data

a. Drainage Area. The drainage area consists of 4 square miles (2,560 acres) of gently to steeply-sloping wooded terrain. The normal recreation level has a surface area of 405 acres, which is equivalent to 16 percent of the watershed.

#### b. Discharge at Damsite

(1) Outlet works (conduits) - Gate 31" W x 34" H @ invert elevation 269' MSL. Gate capacity at spillway crest - 175 cfs @ 281' MSL

(2) The maximum discharge at damsite is unknown. No records of past overtoppings were disclosed.

(3) Stoplog spillway capacity (stoplogs removed) at maximum pool elevation - 370 cfs @ 285.2' MSL

(4) Total project discharge (stoplogs removed) - 1850 cfs @ 287' MSL

c. Elevation. (ft. above MSL) (Elevations are relative to assumed spillway elevation; see (5) below.)

(1) Top of dam - 285.2

(2) Test flood pool - 287

(3) Maximum pool - design surcharge - unknown

(4) Full flood control pool - not applicable

(5) Recreation pool - 281

(6) Spillway crest - 281 (obtained from U.S.G.S. Quadrangle sheet and assumed to be spillway elevation)

(7) Upstream portal invert low-level conduit - 268.2

(8) Streambed at centerline of main dam - 268 (at downstream toe measured 6/13/78)

(9) Maximum tailwater - unknown

d. Reservoir (miles)

(1) Length of maximum pool - 1.9

(2) Length of recreational pool - 1.9

(3) Length of flood control pool - not applicable

e. Storage (acre-feet)

(1) Recreational pool - 2,000

(2) Test flood pool - 4,675

(3) Design surcharge - unknown

(4) Top of dam - 3,900

f. Reservoir Surface (acres)

(1) Top of dam - 500

(2) Test flood pool - 520

(3) Flood control pool - not applicable

(4) Recreation pool - 405

(5) Spillway crest - 405

g. Dam

(1) Type - earthen embankment placed between upstream and downstream vertical dry masonry walls.

(2) Length - 433'

(3) Height - 17' (structural height)

(4) Top Width - ranges from 25' to 36'

(5) Side Slopes - vertical

(6) Zoning - unknown

(7) Impervious core - unknown (However, see sketch of 9/1/39 in Appendix B.)



(8) Cutoff - unknown

(9) Grout curtain - unknown

h. Diversion and Regulating Tunnel. A low-level conduit and sluice gate are located at the base of dam under the stoplog spillway. The flow from the approach channel of the lake enters a forebay that is 8' wide x 14.2' long x 10' deep to the top of the gate. The gate is reported by the NHWRB to measure 31" W x 34" H. (See Appendix B.) The lift mechanism consists of a handle and a wooden stem, fitted with a rack and pinion, to which the gate is attached. The outlet in the downstream face of the masonry wall is about 3' W x 2.5' H, with its invert at the elevation of the downstream channel bottom (268' MSL). The present gate was installed by the owner in May 1975. (See Appendix B.)

i. Spillway

(1) Type - stoplog spillway (stoplogs permanently removed)

(2) Length of weir - 12.3'

(3) Crest elevation - 281' MSL

(4) Gates - none (stoplog notch, no stoplogs)

(5) U/S Channel - Union Lake (Swains Pond)

(6) D/S Channel - The downstream channel is about 25 feet wide and 3 feet deep. It is clear of debris for 50 feet downstream of the dam and has sand, gravel, and boulders on the bottom.

## SECTION 2 ENGINEERING DATA

### 2.1 Design

No original design data were disclosed for Union Lake Dam

### 2.2 Construction

No construction data were disclosed for Union Lake Dam. One sketch made during an inspection report of 9/1/39 by the New Hampshire Water Resources Board (NHWRB) was found and evaluated to determine its acceptability in defining the present conditions of the dam.

### 2.3 Operation

No engineering operational data were disclosed.

### 2.4 Evaluation

a. Availability. Little engineering data were disclosed for Union Lake Dam. A search of the files of the NHWRB revealed only a limited amount of recorded information.

b. Adequacy. Because of the limited amount of detailed data available, the final assessments and recommendations of this investigation are based on the visual inspection and hydrologic and hydraulic calculations.

c. Validity. The sketch of 9/1/39, taken from the NHWRB file and made by one of its inspectors, is generally consistent with the visual inspection.

SECTION 3  
VISUAL INSPECTION

3.1 Findings

a. General. Union Lake Dam is a low dam which impounds an intermediate size reservoir. The watershed area above the reservoir is gently sloping and heavily wooded. The downstream area is gently sloping and heavily wooded. Numerous cottages and homes are sited around the perimeter of the lake.

b. Dam. Union Lake Dam is 433 feet long, 25 to 36 feet wide at the crest, 17 feet high, and had a freeboard of 4 to 5 feet between the elevation of the lake and crest of dam at the time of the inspection. It appears to have been originally constructed as an earthen embankment with upstream and downstream vertical dry masonry walls. Fill has been placed against the downstream face near the north abutment and against the upstream face along the entire length of the dam. The fill against the upstream face between the north abutment and the gatehouse, which is near the center of the dam, appears to have been placed within the last year or two; the other fills appear to be older. Riprap has been placed on the present upstream slope between the south abutment and the gatehouse. Between the gatehouse and the north abutment, some large rocks have been dumped randomly on the slope, but there is no placed riprap or other formal type of erosion protection. (See Appendix C - Figures 2 and 3.)

More than 20 large stumps are visible on the crest of the dam, mostly on the section between the gatehouse and the south abutment. (See Appendix C - Figure 4.) Some of these stumps are as large as 24 inches in diameter, and many of the stumps have radiating roots which are exposed at the ground surface and extend across the entire width of the crest. One large stump had 55 annular rings. Because most of the trees were cut in 1976, this indicates that the dam was built in 1921 or earlier.

Fill which appears to have been placed against the upstream slope north of the gatehouse within the last year or two has widened the crest and may have covered stumps that existed on the upstream portion of the crest at the time the fill was placed. The upstream slope of the dam near the north abutment appears to be used as a swimming beach and as a boat launching and mooring area. Several large trees are growing on the upstream slope near the north abutment. (See Appendix C - Figure 5.)

An expanded house trailer is situated on the downstream slope near the north abutment. (See Appendix C - Figure 6.) About half-way between the north abutment and the gatehouse, a local fill has been placed on the downstream slope and a 4-inch diameter vertical cast iron pipe is located near the center of this fill. (See Appendix C - Figure 7.) (Records indicate that a privy was installed and subsequently removed at this location).

Seepage is occurring near the base of the downstream dry masonry wall on both the north and the south sides of the spillway. The seepage water was clear at the time of the visual inspection. Several feet north of the spillway, a pile of sand and gravel has been dumped at the base of the downstream dry masonry wall and water is seeping all along the edge of this fill. (See Appendix C - Figure 8.) No visible evidence was found to indicate whether this pile of sand and gravel was placed to control seepage or for some other purpose. The total seepage and possible leakage around the seal of the low-level gate is estimated to be about 5 cfs. A wet area was noted downstream of the dam at the south abutment. This area may be the result of groundwater discharging from the sides of the valley or it may be due to seepage under the dam.

Some stumps were noted in the downstream face of the dam. (See Appendix C - Figure 9.) Trees and brush have been cut for a distance of about 50 feet downstream of the dam. Between the north side of the valley and the channel, most of the cut trees and brush have been removed; between the channel and the south side of the valley much of the cut brush has been left lying on the ground. (See Appendix C - Figure 10.)

Visual observation indicated evidence of a stone core wall extending northward from the spillway approximately 40 feet. The wall is located approximately mid-point between the upstream face and downstream face. The subsurface condition and extent of the wall could not be determined from the visual inspection.

### c. Appurtenant Structures

(1) Low-level sluice gate. The low-level sluice gate is located beneath the overflow stoplog spillway. The sluice gate and stoplog spillway structure are constructed integrally with the dam and located approximately mid-point of the dam. Because of the high tailwater and the amount of water flowing over the stoplog spillway, visual inspection of the sluice gate conduit was not possible. About a cubic foot of the stone masonry above the left (north) edge of the low-level outlet has fallen out, and water is leaking from this opening.

(2) Stoplog Spillway. The visual inspection of the stoplog spillway portion of the dam did not reveal any evidence of instability. The sluice gate was neither visible nor operated during the inspection. Visual inspection, however, showed the stem handle and gate operating mechanism to be in poor condition (rusty - no grease). The overflow stoplog spillway is constructed of split stone masonry with mortared joints. Visible portions of the spillway indicated that the mortared joints were in fair condition with some cracking and little deterioration. The stoplog slot is located at approximately mid-point between upstream and downstream face, and is constructed in the stone masonry. The remains of a cofferdam and sand bags used to dewater the low-level outlet in 1975 are still in place at the entrance to the outlet. (See Appendix B.) A wooden gatehouse structure has been built over the stoplog spillway to store the stoplogs and to house the sluice gate operating mechanism. (See Appendix C - Figure 11.) The visual inspection indicates that the gatehouse is deteriorating. The supporting timbers across the spillway do not have protective coatings. The visible portion of the wooden gate lifting stem is deteriorating at the water line. (See Appendix C - Figure 12). No stoplogs were being used at the time of inspection and none were visible in the vicinity of the dam or in the gatehouse. (The NHWRB in 1975 advised the owner to discontinue use of stoplogs so that the full capacity of the spillway could be developed. See Appendix B.)

d. Reservoir Area. The reservoir slopes are gently to steeply sloping and are generally covered with trees and brush. (See Appendix C - Figure 13.) Numerous camps and cottages are sited along the shoreline. Little sedimentation was observed in the reservoir area. Sandy beaches, utilized by the summer residents, flank each abutment of the dam.

e. Downstream channel. The bottom of the channel downstream of the stoplog spillway and sluice gate is covered with sand, gravel and boulders. The channel is about 25 feet wide and is clear of debris for at least 50 feet downstream of the dam. (See Appendix C - Figure 14.) Trees and brush have been cleared from the sides of the channel for at least 50 feet downstream of the dam. A few logs and other forms of debris were visible further downstream.

### 3.2 Evaluation

Based on the visual inspection, the condition of Union Lake Dam is considered to be poor. Significant seepages and leakages which are taking place at the base of the downstream

dry masonry wall on both sides and through the spillway could lead to progressive instability of the dam if piping began at these locations. The cracked mortar in the joints of the stone masonry, if deteriorated further, could cause leakage through the stone masonry and hence erosion of the earth fill.

The extensive network of tree roots at the crest of the dam could provide channels for piping during periods of high water after the roots have rotted. (See Appendix C - Figure 4.)

Habitation and recreational activities on the upstream slope near the north abutment showed no evidence of having resulted in erosion at the time of the inspection. (See Appendix C - Figure 15.) Any future activities that might have a detrimental effect on the integrity of structure must be closely controlled. The upstream slope of the dam between the north abutment and the gatehouse is not adequately protected against wind and wave erosion. Natural erosion of that slope was not serious at the time of the inspection, but could become serious. Past inspection reports by the NHWRB reflect that fill was placed on the upstream slope to correct past erosion in this section of the dam. Although this fill contains many large boulders, it does not constitute placed riprap and hence could also be eroded.

The expanded house trailer is situated on the downstream slope near the north abutment, the privy that was constructed and later abandoned on the downstream slope, and general trespassing on the downstream slope near the north abutment have had unknown effects on the integrity of the dam. Lack of adequate maintenance on the gate house and supporting timbers could lead to collapse of the building into the overflow spillway or to failure of the timber supporting the gate-operating mechanism when a load is imposed during operation of the sluice gate.

The deteriorated condition of the stem, questionable condition of the gate seal, and poor condition of the operating mechanism may prevent the use of the gate to lower the level of the reservoir.

## SECTION 4 OPERATIONAL PROCEDURES

### 4.1 Procedures

No written operational procedures exist for Union Lake Dam. The lake level is maintained by the uncontrolled spillway located near the center of the dam. The stoplogs have been permanently removed to allow for a larger spillway capacity. The lake level fluctuates depending upon the amount of inflow.

### 4.2 Maintenance of Dam

Mrs. Gail P. Chase is responsible for the maintenance of Union Lake Dam. The dam is visited periodically by the owner.

### 4.3 Maintenance of Operating Facilities

The sluiceway running through the base of the dam is opened only for repair purposes. The operation of the gate was not observed during the visual inspection. The stem handle and gate operating mechanism were in poor condition.

### 4.4 Description of Any Warning System in Effect

No written warning system exists for Union Lake Dam. In case of any abnormal conditions noted by the residents around the lake, they notify the owner by phone.

### 4.5 Evaluation

The current operation and maintenance procedures for Union Lake Dam are inadequate to insure that all problems encountered can be remedied within a reasonable period of time. The owner should establish a written operation and maintenance procedure as well as establishing a warning system to follow in event of floodflow conditions or imminent dam failure.

SECTION 5  
HYDROLOGY AND HYDRAULIC ANALYSIS

5.1 Evaluation of Features

- a. Design Data. No hydrologic or hydraulic design data were disclosed for Union Lake Dam.
- b. Experience Data. No information regarding past overtopping of Union Lake Dam was disclosed.
- c. Visual Observations. At the time of the inspection, no visual evidence was noted of damage to the structure caused by overtopping.
- d. Overtopping Potential. Union Lake Dam is classified as being intermediate in size having a maximum storage capacity of 3,900 acre-feet. The normal recreation level has a surface area of 405 acres, which is equivalent to 16 percent of the watershed.

To determine the hazard classification for Union Lake Dam, the impact of failure at maximum pool was assessed using Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers. The analysis covered the reach from the dam to State Route 125, a distance of approximately 1.7 miles. Failure of Union Lake Dam at maximum pool would probably result in an increase in stage of approximately 9 feet along the reach. An increase in water depth of this magnitude would probably sever Lake Side Oaks Road, a gravel road which provides access to the dam and several campsites. Hall Road, located about 0.2 miles downstream of the dam would also suffer severance. This would be due, in part, to the high velocity of the released water. Hall's Mill Site, located just upstream of Hall Road, contains remains of an old dam. This area will provide no storage, and the high velocity of water would probably pick up many of these loose boulders increasing the damage to Hall Road. Pierce Road, a gravel road, and State Route 125, located about 1.7 miles downstream of the dam, would also suffer severance. Except for the expanded house trailer located on the north abutment, no other inhabited structures would likely be endangered. Immediately downstream of State Route 125 is a wetland area that should provide buffer storage and mitigate further downstream effects.

As a result of the analysis described above, Union Lake Dam was classified - Significant Hazard. Using OCE Recommended Guidelines for Safety Inspection of Dams, the recommended test flood is the Probable Maximum Flood. The test flood



inflow for Union Lake Dam, having a drainage area of 4 square miles, was determined to be 3390 cfs (848 csm). The test flood discharge after routing was determined to be 1850 cfs (463 csm).

Union Lake Dam is unable to pass the test flood without overtopping. The water depth over the dam embankment was calculated to be 1.8 feet. Neither will the dam pass one-half the test flood without overtopping. The water depth over the dam during one-half test flood was calculated to be 1.3 feet. The spillway capacity is only 20 percent of the test flood discharge.

## SECTION 6 STRUCTURAL STABILITY

### 6.1 Evaluation of Structural Stability

#### a. Visual Inspection

(1) Dam Embankment. Visual observation did not reveal any evidence of existing instability. However, several areas were identified as potential structural stability problems.

(a) Significant seepages at the downstream dry masonry wall on both sides of the spillway could lead to instability if piping began at these locations.

(b) The extensive network of tree roots from large stumps at the crest of the dam could provide conduits for piping during periods of high water after the roots have decayed.

(c) Continued habitation and recreational activities on the upstream slope near the north abutment could lead to extensive erosion.

(d) The effects of unrelated construction and trespassing on the downstream slope are unknown. However, continued trespassing and potential for modification and other unrelated construction activities by the property owners or other parties may pose problems to the dam stability depending on the type and extent of such activity.

(e) The condition and extent of the core wall could not be determined from the visual inspection.

(2) Appurtenant Structures. Visual inspection of the spillway and sluice-gate structure did not reveal any evidence of instability. However, the wooden gate house and supporting timbers have deteriorated and do not have protective coatings. The mortared joints between the dry masonry walls are cracked and subject to deterioration by weathering.

b. Design and Construction Data. No design and construction data were disclosed for the original dam construction.

c. Operating Records. No operating records were disclosed.

d. Post Construction Changes. Several feet of granular fill has been dumped on the upstream face between the spillway

section and the north abutment within the last two years. (See Appendix B.) Reports indicate that repairs to the sluice gate possibly including pouring of a concrete pad in the bottom of the sluice gate forebay were made in late 1975. The remains of the cofferdam used during the reconstruction work in 1975 are as yet in place in the approach leading to the gated outlet.

e. Seismic Stability. The dam is in Seismic Zone 2 and hence does not have to be evaluated for seismic stability according to the OCE Guidelines.

SECTION 7  
ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual inspection indicates that the dam itself is in poor condition. The major concerns with respect to the overall long-term stability of the dam are:

- (1) Overtopping potential;
- (2) Seepage near the base of the downstream dry masonry wall on both sides of the spillway;
- (3) A large number of stumps and radiating roots on the crest of the dam;
- (4) Lack of proper erosion protection on the upstream face of the dam between the gatehouse and the north abutment;
- (5) Trespassing on the upstream slope of the dam, including use as a swimming beach, boat launching, and boat mooring;
- (6) Construction on the downstream slope of the dam, including an expanded house trailer and an abandoned privy; and
- (7) Possible seepage near the south abutment.

b. Adequacy of Information. The information available is such that the assessment of the dam must be based entirely on the visual inspection.

c. Urgency. Either the recommendations outlined in 7.2 or the alternative given in Subsection 7.3.a. below should be implemented by the owner within one year after receipt of this Phase I Report. The operating and maintenance procedures enumerated in Subsection 7.3.b. below should be implemented promptly after receipt of this Phase I Report and discontinued only upon draining and breaching.

d. Need for Additional Investigation. The information available from the visual inspection is adequate to identify the potential problems which are: overtopping, seepage, lack of erosion protection, and trespassing and construction on the dam. These problems require the attention of a competent engineer who will have to make additional engineering studies to design or specify remedial measures to rectify

the problems. If left unattended, the problems could lead to instability of the structure.

## 7.2 Recommendations

The owner should engage the services of a registered professional engineer to:

a. Evaluate further the hydrology and hydraulics of the dam and to design measures to reduce the possibility of failure due to overtopping, if required;

b. Design the remedial measure to eliminate the seepage at the base of the downstream dry masonry wall on both sides of the spillway;

c. Supervise the removal of all stumps and roots and properly backfill all void created;

d. Design and specify erosion protection measures for the upstream face of the dam between the gatehouse and the north abutment;

e. Evaluate, in detail, the condition of the upstream face of the spillway and sluice gate to determine the integrity of the stone masonry, and design remedial measures, if required;

f. Evaluate the seepage near the south abutment and design remedial measures, if warranted; and

g. Evaluate the effects of the habitation and abandoned privy, on the downstream slope, and use of the adjacent beaches on the overall long-term integrity of the dam.

## 7.3 Remedial Measures

a. Alternative. As an alternative to the recommendations in 7.2 above, the owner should engage the services of a registered professional engineer to design and specify the required procedures to drain, breach, and preclude the impoundment of water at the dam.

### b. Operating and Maintenance Procedures

(1) Keep brush and trees from growing on the slopes of the dam and an area 50 feet downstream of the dam.

(2) Develop a written operational procedure and a warning system to be followed in the event of floodflow

conditions or imminent dam failure.

(3) Monitor seepage downstream of the dam on a weekly basis.

(4) Repair and maintain in good condition the gate house, gate operating mechanism, and gate.

(5) Allow no flashboards or stoplogs to be inserted in the spillway.

(6) Prevent further unrelated construction on the dam and slopes.

(7) Continue periodic inspection systems on a bi-annual frequency.

(8) The owner should provide round the clock surveillance during periods of unusually heavy precipitation.

(9) In order to keep the spillway free from debris, a log boom should be installed.

**APPENDIX A**  
**CHECK LIST - VISUAL INSPECTION**

# VISUAL INSPECTION CHECK LIST

## PARTY ORGANIZATION

PROJECT Union Lake Dam, N.H.

(Swains Pond)

DATE June 13, 1978

TIDE 10:30 A.M.

WEATHER Warm, cloudy

W.S. ELEV. 281.3 U.S. 271 DN.S.

### PARTY:

- |                             |           |
|-----------------------------|-----------|
| 1. <u>Warren Guinan</u>     | 6. _____  |
| 2. <u>Stephen Gilman</u>    | 7. _____  |
| 3. <u>Robert Langen</u>     | 8. _____  |
| 4. <u>Ronald Hirschfeld</u> | 9. _____  |
| 5. <u>John Falcione</u>     | 10. _____ |

PROJECT FEATURE	INSPECTED BY	REMARKS
1. <u>Hydrology/Hydraulics</u>	<u>R. Langen</u>	
2. <u>Structural Stability</u>	<u>S. Gilman</u>	
3. <u>Soils and Geology</u>	<u>R. Hirschfeld</u>	
4. <u>Mechanical</u>	<u>J. Falcione</u>	
5. _____	_____	
6. _____	_____	
7. _____	_____	
8. _____	_____	
9. _____	_____	
10. _____	_____	



# PERIODIC INSPECTION CHECK LIST

PROJECT Union Lake Dam, N.H.

DATE June 13, 1978

PROJECT FEATURE Dam Embankment

NAME \_\_\_\_\_

DISCIPLINE \_\_\_\_\_

NAME \_\_\_\_\_

AREA EVALUATED	CONDITIONS
<b>DAM EMBANKMENT</b>	
Crest Elevation (spillway, no stoplogs)	281 ft. MSL (from U.S.G.S. Quadrangle map)
Current Pool Elevation	281.3 ft. MSL
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed*
Pavement Condition	Not paved
Movement or Settlement of Crest	None observed*
Lateral Movement	None observed
Vertical Alignment	Good
Horizontal Alignment	Good*
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None visible
Trespassing on Slopes	Extensive
Sloughing or Erosion of Slopes or Abutments	Some erosion of new fill at upstream face between north abutment and gatehouse.
Rock Slope Protection - Riprap Failures	New fill between north abutment and gatehouse not adequately riprapped
Unusual Movement or Cracking at or near Toes	None observed
Unusual Embankment or Downstream Seepage	Seepage at downstream toe of wall at north side of spillway
Piping or Boils	None observed
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation System	None observed

\*New fill placed on upstream slope of dam between north abutment and gatehouse.

PROJECT Union Lake Dam, N.H.

DATE June 13, 1978

PROJECT FEATURE Intake Channel & Structure NAME \_\_\_\_\_

DISCIPLINE \_\_\_\_\_

NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u>	
a. Approach Channel	
Slope Conditions	Not visible
Bottom Conditions	Not visible except coffer dam (note below)
Rock Slides or Falls	None
Log Boom	None
Debris	Remains of coffer dam (timber and sandbags) submerged at entrance
Condition of Concrete Lining	Stone masonry filled with mortar - no visible movement
Drains or Weep Holes	None
b. Intake Structure	
Condition of Concrete	Stone masonry
Stop Logs and Slots	No stoplogs; lugs of masonry to hold stoplogs

# PERIODIC INSPECTION CHECK LIST

PROJECT Union Lake Dam, N.H.

DATE June 13, 1978

PROJECT FEATURE Control Tower

NAME \_\_\_\_\_

DISCIPLINE \_\_\_\_\_

NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - CONTROL TOWER</u>	
a. Concrete and Structural	
General Condition	Deteriorating wooden shed, timber supports unpainted
Condition of Joints	Stone masonry; joints filled with mortar
Spalling	Little
Visible Reinforcing	Not applicable
Rusting or Staining of Concrete	None
Any Seepage or Efflorescence	Not visible
Joint Alignment	No visible movement
Unusual Seepage or Leaks in Gate Chamber	Substantial leakage and seepage on D.S. face around outlet.
Cracks	
Rusting or Corrosion of Steel	Not applicable
b. Mechanical and Electrical	
Gate lifting mechanism	Rack & pinion (rusty) no grease
Gate	Not visible - replaced in 1975 per owner.

# PERIODIC INSPECTION CHECK LIST

PROJECT Union Lake Dam, N.H.

DATE June 13, 1978

PROJECT FEATURE Outlet Structure & Channel

NAME \_\_\_\_\_

DISCIPLINE \_\_\_\_\_

NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	
General Condition of Concrete	Low-level outlet of stone masonry built integrally with upstream and downstream walls
Rust or Staining	Outlet under water - condition unknown
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	Noticeable seepage around outlet
Condition at Joints	Not visible
Drain holes	Unknown
Channel	
Loose Rock or Trees Overhanging Channel	50' downstream of dam - some overhanging trees
Condition of Discharge Channel	Clear with sand, gravel, and boulders; about 2½ feet deep at downstream face of dam.

# PERIODIC INSPECTION CHECK LIST

PROJECT Union Lake Dam, N.H.

DATE June 13, 1978

PROJECT FEATURE Spillway Weir

NAME \_\_\_\_\_

DISCIPLINE \_\_\_\_\_

NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	
a. Approach Channel	Overflow spillway is in center of dam.
General Condition	Union Lake (Swains Pond)
Loose Rock Overhanging Channel	Remains of coffer dam about 1 foot below level of spillway in approach channel
Trees Overhanging Channel	None
Floor of Approach Channel	Unknown
b. Weir and Training Walls	
General Condition of stone & masonry	Fair condition
Rust or Staining	Not applicable
Spalling	Not apparent
Any Visible Reinforcing	Not applicable
Any Seepage or Efflorescence	None visible
Drain Holes	None
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Some, about 50 feet downstream
Floor of Channel	Sand, gravel, and boulders
Other Obstructions	Some logs next to channel

<u>PROJECT</u>	<u>DATE June 13, 1978</u>
<u>PROJECT FEATURE Reservoir</u>	<u>NAME R. Langen</u>
<u>AREA EVALUATED</u>	<u>REMARKS</u>
Stability of Shoreline	Good
Sedimentation	Not visible
Changes in Watershed Runoff Potential	Minor
Upstream Hazards	Many homes; lowest is 6' above lake
Downstream Hazards	Three roads, two culverts, some homes; lowest is 6' above channel
Alert Facilities	None observed
Hydrometeorological Gages	None
Operational & Maintenance Regulations	None observed

APPENDIX B  
INSPECTION REPORTS/SKETCHES

TO: Vernon A. Knowlton, Chief Engineer  
FROM: Donald M. Rapoza, Civil Engineer  
SUBJECT: Swains Lake (Union Lake) Barrington Dam #15.02  
DATE: September 14, 1977

During the week of August 15, 1977, Mr. Peabody called me requesting another inspection of the sluiceway as he was concerned with the leakage. I made arrangements for a site viewing at 9:00 p.m., August 19, 1977.

While waiting for Mr. Peabody, a neighbor informed me that Mr. Peabody had died the previous day.

I did meet with Mr. Lawrence Ketchen, a semi-retired professional engineer employed by the town on a part-time basis, and viewed the leakage area.

The leakage is approximately the same volume as viewed in my March 20, 1975 inspection. Presently, the leakage through the cut stone sluiceway does not effect the safety of the structure. As mentioned in correspondence with Mr. Peabody, the leakage should be monitored periodically.

Last year Mr. Peabody mortared the granite block joints in the sluiceway area which did reduce the leakage. I believe that during the winter months, the joints froze and cracked allowing water to seep through the joints. I made mention of this fact to Mr. Peabody in that jointing was a temporary solution and if the dam was under state ownership we would construct reinforced concrete walls in the sluiceway.

On August 29, 1977, the Board received a letter from Carl P. Chase, Mr. Peabody's daughter, who stated that she was going to open the sluice gate the week of August 29, 1977 to make necessary repairs to the dam.

DMR:njk



LAWRENCE L. KETCHEN

Registered Professional Engineer

~~663-2604-171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000~~

France Rd.

Barrington, N. H. 03825

664-2658

Board of Selectmen

Barrington, N. H. 03825

re. Swain's Lake Dam

Gentlemen:-

During the past six months I have followed the repair work being carried out on the Swains Lake Dam as an item of professional interest and after your request that I attend the meeting with the representative of the N. H. Water Resources Board on October 13, 1976, I have continued to follow the work in greater detail.

Prior to the October meeting, I had examined the downstream face of the dam for evidence of leakage through the earth core of the dam. I found no evidence of "piping" or percolation through or under the dam.

During the examination period, the lake surface was held at a level about five feet above the base of the sluice gate floor by means of a gravel and sand bag cofferdam. A corrugated metal pipe was driven into the cofferdam to permit the draining of the sluice gate floor. At the October meeting, I requested that the sluice gate be closed and the forebay flooded to the existing lake level. Examination of the downstream face of the granite block sluice gate structure revealed two minor leaks on the right hand side and one on the left side. The representative of the N.H.W.R.B. and I concurred in the view that these leaks represented percolation in the sluice gate rock and not in the dam. Subsequent routing of the joints between the massive granite blocks forming the overflow and gate structure sealed the leaks and confirmed our earlier conclusions.

I presented the opinion that the forebay floor should be constructed to provide a water cut off at that level and reduce the possibility of hydrostatic uplift on the structure. This proposal was accepted and has now been completed.

The owner of the dam has cut off the trees growing on the dam and has roughed out an access road adjacent to the left (west) embankment.

It is my finding that the dam, sluiceway and gate structure are structurally sound and pose no danger to downstream property or persons.

2/2/77

Two items involving the operation of the dam have been brought to the attention as follows:

1. The use of flashboards to raise the surface of the lake to a convenient or useable levels.
2. Provide an overflow section to relieve or eliminate the possibility of storm flows overtopping the dam structure.

Flashboards are a common method of providing control of the lake. A flashboard support structure and properly designed collapsible flashboards will provide the control required and eliminate the possibility of overtopping.

In reviewing the need for an overflow section, I have determined the total drainage area for Swains Lake using U.S.C. & G.S. plates. The area is four and one half square miles, a very small drainage area. There are no streams of size flowing into the lake and it follows that no flow data are available. Peak flood conditions must therefore be developed from precipitation data and consideration of the physical characteristics of the drainage basin. The slopes of the basin are gentle and predominately covered with heavy vegetal growth providing high surface detention, infiltration and storage capacity to storm rainfall. The northwesterly end of the basin is characterized by series of small beaver ponds and swamp areas providing additional storage and detention capacity to storm flows.

It is my opinion that the application of any of the standard runoff formulas to this particular drainage basin will result in calculations that will be unreasonably conservative. It is my further opinion that an overflow spillway section in addition to the existing sluiceway is not required.

If the dam is offered to the Town of Farrington, the offer should be contingent upon satisfactory completion of the following:

1. Construction of a useable road to provide access to the dam embankment.
2. Establishment of appropriate land boundaries for the dam and dam structure.
3. Establishment of clear title to the land and water rights to the present owner.
4. Design and construction of an N.H.W.R.B. approved flood control structure if the operating level of the lake is to be established above the invert of the sluiceway.

Yours very truly,

Lawrence L. H. [Signature]

January 17, 1977

Mr. Myron F. Peabody  
Hall Road  
Barrington, NH 03825

RE: Dam #15.02

Dear Mr. Peabody:

The New Hampshire Water Resources Board has received your letter dated December 1, 1976 requesting a statement regarding the condition of your dam at the outlet of Swains Lake in Barrington.

At the present time, your dam is structurally sound and meets our safety requirements for structural integrity. As mentioned in correspondence dated November 19, 1976 the gate section was not completely sealed and should be periodically monitored but this should not adversely effect the structure. Even with today's modern dam construction techniques, very few dams are completely free from seepage. The main concern with any type of seepage is mainly twofold: 1. the location of the seepage areas and 2. the control of seepage through the structure.

The Board is not requiring you or anyone who acquires the structure to completely curtail all seepage going through the gate section. The present structure has existed for many years and has weathered many storms and with proper management and maintenance and varying any major catastrophe, there is no reason why this structure should maintain its integrity.

Hopefully this letter meets your request for information regarding the dam; if not, feel free to call or write for additional information.

Cordially yours,

George M. McGee, Chairman

GMMG:DMR:njk

December 1, 1976

Mr. Myron Peabody  
Hall Road  
Barrington, NH 03825

Dear Mr. Peabody,

This letter is the result of my November 19, 1976 inspection of your dam at the outlet of Swains Lake in Barrington.

The main purpose of the inspection was to inspect the sluiceway after you had made the necessary repairs to the granite joints. After the gate was closed and the sluiceway was filled approximately 1 1/2 below the existing pond, leakage was observed through the gate section and at the base of the structure, approximately three feet left of the outlet.

It is my opinion that most of the leakage was coming through the gate section and it was suggested that you monitor the leakage at the gate throughout the winter months. Perhaps the gate will seal itself against the stone facing when the lake develops a larger head.

The leak at the base of the dam presents no major problem at this time, but it should be monitored with the gate leakage. Presently, the caulking of granite joints in the sluiceway have reduced the discharge through the granite facing.

Request you call our office if you need any additional information.

Sincerely yours,

Donald M. Rapoza  
Civil Engineer

DMR:njk

c.c. Swains Lake Association  
Town of Barrington

# State of New Hampshire

## WATER RESOURCES BOARD

CONCORD 03301

November 8, 1976

Mr. Myron Peabody  
Hall Road  
Barrington, N.H. 03825

Dear Mr. Peabody:

This letter is the result of an October 13th, 1976, inspection of your sluicing and gate section on the dam at the outlet of Swains Lake in Barrington.

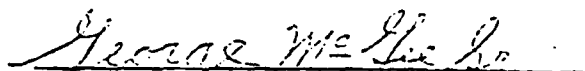
The report indicates that leakage adjacent to the gate section as reported in our October 8th, 1976, letter had stopped. When the gate was closed and the chamber recharged, leakage began on the downstream face of the dam and adjacent to the outlet. This indicates that the leakage that was previously observed came from the gate and/or the sluiceway stone walls. This condition should be corrected by an acceptable sealant method.

The report also indicates that the gate could not be fully opened due to the limited travel length of the cast iron rack located on the wooden stem. The gate must be raised sufficiently to provide discharges through a clear opening. Revised discharge calculations show that the dam can safely pass approximately 280 cubic feet per second with a projected 100-year storm calculation of 510 cubic feet per second.

As you can see the existing dam cannot pass our projected 100-year storm. The Board will not insist that you provide additional discharge capacity, but will require that the existing capacity of the structure not be diminished.

We request that you inform the Board when all repairs mentioned in this letter and our letter of October 8th, 1976, are completed.

Sincerely,



George W. McGee, Sr.  
Chairman

GTM/DNR:L  
cc: Town of Barrington  
Swains Lake Association

M A H C

FROM: Donald Papoza, Civil Engineer

October 18, 1976

TO: Vernon A. Knowlton, Chief Engineer

RE. INSPECTION OF SWAINS LAKE DAM #15.02

On October 13, 1976, I inspected the sluiceway and gate mechanism on the dam at the outlet of Swains Lake in Barrington. The lake was approximately 5 ft. below the permanent crest and a cofferdam was preventing a complete lowering of the lake.

The leakage mentioned in my last memo at the downstream side of the structure was terminated. The gate could not be opened fully to clear the gate opening. Therefore, the previous flow through the structure can be attributed to leaks in the cut stone sluiceway walls and leakage at the gate section. We found no other openings other than the gate as previously thought.

Mr. Peabody stated that he was going to grout the cut stone joints in the sluiceway walls and pour a concrete floor slab. When this is completed there should be a considerable reduction in the seepage through the structure. This could be rectified by installing another rack on the wooden stem or make some other provisions to raise the gate. Approximately 8 inches of gate was below the top of the gate opening. Gate opening 31 in. wide x 34 in. high: Top of opening 10 ft. below permanent crest.

The gate was closed and the sluiceway was flooded by removing sandbags from two culverts. With an increase in water level in the sluiceway chamber, water began seeping at the downstream face of structure.

DER:L

B - 7

October 8, 1976

Mr. Myron Peabody  
Hall Road  
Barrington, New Hampshire 03825

Dear Mr. Peabody:

On September 3, 1976 an engineer from our office inspected your dam (\$15.05) at the outlet of Swain's Lake in Barrington.

Under the provisions of RSA-Chapter 482, Sections 8 through 15, the New Hampshire Water Resources Board is authorized to inspect all dams in the state which by reason of their physical condition, height and location may be a menace to the public safety.

Your dam has been classified by the Board as a menace dam and must be maintained and operated in such a manner as not to endanger the general public.

The following is a list of deficiencies which were found during the inspection:

1. Trees and woody growth should be removed from the top, upstream and downstream side of the structure. The root system of the trees should be removed only when the integrity of the structure is not impaired. Any remaining holes should be backfilled and compacted with pervious to semi-pervious fill.
2. The top of the dam should be regraded and the rotted areas filled with acceptable material. The top of the dam should be crowned so rainwater will drain and not puddle on the structure.
3. There is some leakage at the base of the downstream side of the outlet. The source of the leakage could not be determined at that time.

It was mentioned that you were going to draw the lake down and make some repairs to the interior walls of the sluiceway and you were going to notify our office as to the elevation of the lake in order that an inspection and evaluation of the gate section could be made by our engineering staff.

As of this date we have not been contacted for a re-examination of the gate section and evaluation of the leakage. We request you contact our office and report the status of your repairs.

Because this dam is classified as a menace structure we require that you send us a proposed schedule of repairs within 30 days. If you have any questions, please contact us at your convenience.

Sincerely,

George M. McGee  
Chairman

GMMG/DR/km

October 8, 1976

Swains Lake Association  
P. O. Box 141  
Barrington, New Hampshire 03825

Attention: Mr. Stan Curran, President

Dear Mr. Curran:

This is in reply to your letters dated August 25, 1976 and September 30, 1976 regarding the dam at the outlet of Swains Lake in Barrington.

The inspection memorandum report indicates that the following items need to be rectified by Mr. Peabody, present owner of the dam:

1. Trees and woody growth should be removed from the top and either side of the dam.
2. The top of the structure should be graded and crowned so that rain water will not collect on top of the structure.
3. Considerable quantity of water was passing through the structure, and at the time of the inspection, the source of the discharge could not be determined.

Our office was to be notified when the lake was drawn down to evaluate and inspect the sluice gate. As of this date we have not been notified as to the status of lake level in order that we can inspect the discharge structure. Until this inspection is completed we cannot give you a complete report.

If you have any questions, feel free to write or call.

Sincerely yours,

George M. McGee  
Chairman

GMMG/DR/vm

cc: Myron Peabody



September 17, 1976

Water Resources Board

TO: Vernon A. Knowlton, Chief Engineer

FROM: Donald M. Rapoza, Civil Engineer

SUBJECT: INSPECTION OF SWAINS LAKE DAM IN BARRINGTON

On September 3rd, 1976, I met with Mr. Shirley and Mr. Curan from the Swains Lake Association Inc. and Mr. Peabody, owner of the dam at the outlet of Swains Lake (Union Lake) in Barrington.

The purpose of the meeting was to inspect the structure and reply to the association's letter dated August 25th, 1976.

The gate and sluicing could not be inspected due to pondage. Mr. Peabody was going to drain the pond to repair the sluiceway and he was going to notify our office when the pond was lowered in order that we inspect the outlet works.

We need to know the existing measurements of the gate opening before we can determine the discharge capacity of the gate section. Previous inspection report indicates a 4 x 4 foot gate which I believe to be incorrect according to information given to me by Mr. Peabody.

Trees and woody growth should be removed from the structure. The top of the structure should be regraded. There is water coming from the sluiceway area on the downstream side of the outlet as well as seepage on either side of the outlet. It was mentioned that the structure was built with two 8 in. x 8 in. opening in the sluiceway. This could not be confirmed during my inspection. If this is not substantiated by a later inspection when the pond is drawn down, there would be considerable leakage through the structure.

The association was quite concerned with our statement in a letter to the town which states the dam is not safe to pass the 100-year storm. They cannot understand why the dam is not safe should the State acquire the structure and safe if the association purchases the structure.

This led to a great amount of confusion during the town meeting in which only certain sections of our letter was read at the meeting. Mr. Peabody was also upset because he hadn't received a copy of our letter to the town.

The association indicated that they possibly would want someone from the Board at the next town meeting to answer any questions should the acquisition of the dam be put forth at a future town meeting.

DMR:L

STATE OF NEW HAMPSHIRE  
WATER RESOURCES BOARD

37 Pleasant St.  
CONCORD 03301

July 1, 1976

Mr. W. Richard Burrows, Chairman  
Board of Selectmen - Town of Barrington  
Canaan Road  
Barrington, New Hampshire 03825

Dear Mr. Burrows:

At the request of the town of Barrington, the Water Resources Board has reviewed the Plan of Land of Myron Peabody at Union Lake (or Swains Lake) in Barrington, N.H. The following items regarding the Plan of Land and the Dam should be considered if the town anticipates acquiring this property:

DAM:

This stone and earth dam, in the opinion of the Water Resources Board, is in need of considerable work. It is not in such a condition that it threatens the life and safety of the public, however, it has been neglected in several areas.

The earth embankments have been allowed to grow up with trees whose root system can cause damage in the event of the trees being blown down and dead root systems provide paths for water which could lead to a failure.

The top of the dam needs to be re-graded, the upstream side of the dam has been eroded and in some areas back-filled with uncompacted material of a gravel nature.

An inspection of the outlet structure without benefit of operating the gate indicates that the gate repairs recently made provide a tight gate. However, leakage around the gate structure is considerable and we would estimate that considerable money would have to be spent to seal off this leakage.

The embankments on both sides of the gatehouse are leaking and would require some type of cutoff wall construction to keep this leakage from damaging the embankment.

July 1, 1976

The Water Resources Board is of the opinion that the spillway in this dam is totally inadequate and for safe operation should be expanded. We believe the nature of the original dam construction could be modified to accommodate an additional 20 - 30 ft. width in the spillway.

An off-the-cuff estimate to restore this dam to meet the Water Resources Board's standards would be approximately \$50,000. Those same requirements would not necessarily be made of the Town and the repairs could be made over a long period of time by town forces at substantially less cost.

Proposed Land Transfer:

Access to the dam from the east shows an angular approach along a right-of-way from Lakeside Oaks Drive. We recommend that the access follow the direction of the dam between the two camps with a wider width as physically possible.

The stone construction of the dam is visible along this recommended alignment and to preserve the dam this area should be deeded to the town and not a right-of-way. The right-of-way could be given to the camp owners across this area for their use of the shore line. The camp downstream of the dam in the area of the proposed right-of-way does not materially affect access to the dam and does not necessarily have to be removed.

We believe access along the top of the dam to the downstream portion of the dam could be accomplished with a small amount of fill over the stone embankment to allow trucks and equipment to reach the downstream portion of the dam. The 30 ft. wide strip of land downstream of the dam appears to be adequate to meet the construction needs at the dam. Any proposed construction on this dam would normally require access upstream of the dam into the pond area.

The transfer of title should run from the dam to the normal water level of the pond around the pond back to the limits of the tract on the opposite side of the structure. In other words, it should include the bed of the lake in total. In addition to this acquisition should be the rights to flow any land above the water level during times of high water to the top of the existing dam. This would protect the town from any damages caused to docks and shorelines from high water conditions beyond the town's control.

July 1, 1976

On the westerly side of the dam the proposed limit of acquisition as shown is 10 - 15 ft. short of the end of the dam. The dam continues into land of C. Arthur for that distance. Downstream of the corner of the proposed boundary and the wall of the dam, the grade does rise sufficiently that the dike could be extended in this direction without acquiring additional land from the Arthur property.

Upstream of the dam the proposed boundary runs to an existing iron pipe. The line continues to an existing D.H. in rock. In inspecting this area it appears that the camp owners road at the corner of the Arthur property splits into two right-of-ways to the water. One of them lies within the area between the I.P. and D.H. and the prospective owner should insist that they have the right to use this right-of-way for purposes of operation, inspection, and construction of this dam.

In the event of a severe flood it is highly unlikely that Lakeside Oaks Drive will be passable since the culvert across the Bellamy River below the dam is so small that any reasonable flow could wash out this road. The only useable access would be from the westerly side.

The Town should also insist that the deed carry such phrases as "together with all flowage rights, lands, easements, rights-of-way, appurtenances, etc. and any other rights connected with the dam at the outlet of Swains or Union Lake" to insure there are no conditions outstanding which the town would not be aware of.

Members of our staff would be available to go over these recommendations with the Board of Selectmen at your convenience.

Sincerely,

---

George M. McGee, Sr.  
Chairman

DATE: September 24, 1975  
FROM: GARY L. HERR, Water Resources Engineer  
SUBJECT: Gate Repair - UNION LAKE - 15.02  
TO: VERNON A. KNOWLTON, Chief Engineer

On September 19, 1975, I inspected the gate and found the repair satisfactory. The lake level was being drawn down to allow repairs to be made on the lakeside face of the dam. This work involved repointing of the mortar to stop minor leakage.

I told Mr. Peabody that he might consider one additional measure to stop the leakage through the dam. That being to apply a montmorillonite seal to the upstream face and then to backfill with sand.

GLK/nb

WATER RESOURCES BOARD

87 Pleasant St.  
CONCORD 03301

April 9, 1975

Mr. Myron Peabody  
Hall Road  
Barrington, New Hampshire

Dear Mr. Peabody:

On March 18, 1975, you notified the New Hampshire Water Resources Board and requested assistance in controlling leakage on your dam at the outlet of Union Lake in Barrington.

This same day, an engineer from our office inspected the site and reported the discharge gate at the base of the dam was apparently inoperable, and water from the gate section was overflowing your camp road and eroded a gravel roadway immediately upstream of Route 125. On March 20, 1975, another site inspection was made and it was reported that the spillway above the gate section was restricted by a non-failing timbered flashboard and a heavy planked barrier across the spillway opening.

The entire discharge gate and spillway capacity is required to pass flood flows, and you will be required to make the necessary repairs to the damaged gate section and remove all restrictions above the granite slab spillway invert.

If you have any questions, feel free to call or write this office.

Very truly yours,

George M. McGee, Sr.  
Chairman

gmmg/dmr:js  
certified mail

MEMORANDUM

DATE: March 27, 1975

FROM: Donald M. Rapoza, Water Resources Engineer

SUBJECT: Investigation of reported leakage at Union Lake Dam  
in Barrington - #15.02

TO: Vernon A. Knowlton, Chief Water Resources Engineer

On March 18, 1975, Mr. Myron Peabody, owner of the dam at the outlet of Union Lake in Barrington, called and requested our assistance in controlling the leakage from his dam.

At the site, I met Steve Lenzi, the Town road agent, and we viewed the area and found the following:

1. Water was approximately four inches from flowing over Hall Road. The 4 ft. diameter CMP culvert under the town road, Hall Road, was flowing 1/2 full at the outlet.
2. A gravel road, Lake Side Oaks Road, which provides access to the dam, a few camps, and full time residences was topped for approximately 50 feet in length and a maximum depth of 1 1/2 feet. The road was gradually being washed away due to the high water velocity.
3. At the dam approximately three inches of water was going over an 8" x 10" log in the spillway section. Flow was also going through the gate section. The gate house was locked, but the gate stem was intact and positioned in the lifting mechanism.
4. Checking further downstream of the dam on the Bellamy River and upstream of Route 125, I found the river flowing through what I believe to be two culverts, and the gravel roadway over and adjacent to the culverts was being washed away.

At the dam site, I spoke with Mrs. Steele, who first noticed the increased flow in the river. She placed the timing approximately at 10:30 a.m., March 18, 1975. I also spoke with Mr. Peabody regarding his request to the New Hampshire Water Resources Board for assistance. It is my opinion that the gate section was damaged. The gate could not be viewed from the downstream side of the dam due to a backwater condition. Mr. Peabody mentioned that the last gate operation was done some five to six years ago.

Mr. Peabody was concerned about blocking the gate opening in order to stabilize the lake level, but I suggested that Mr. Peabody's responsibility was to himself and the public safety, and that his primary concern should be the repair of the gate. It was also suggested that he



dewater the gate sluiceway through the dam by taking advantage of a cofferdam upstream of the gate section. This could be done by sand-bagging around the existing cofferdam.

On March 20, 1975, I viewed the site again. The water had receded on Hall Road and Lake Side Oaks Road. The operator of a backhoe mentioned that they had reduced the flow through the culverts, but the previous rains had increased the flow. The flow was reduced by using a heavy planked barrier placed in front of the spillway opening. Flow was going around both ends of the planks. By restricting the flow in this manner, Mr. Peabody had created a potentially dangerous situation should the drainage be hit by a large rainstorm. I spoke with Mr. Peabody about this, and he agreed that the planking be removed above the granite slab spillway invert and that the timber in the spillway section be removed until the gate is repaired. The gate stem had fallen from the lifting mechanism and was tilting to one side of the sluiceway.

Mr. Peabody was waiting to hear from the Governor's Office and a call from Washington regarding the acquisition of burlap sandbags. This same day I also mentioned to the backhoe operator that it was my opinion that sand bagging upstream of the existing cofferdam would be the most practical way of dewatering the sluiceway.

I left all the necessary forms for the repairs to the structure with Mr. Peabody. Recommend that the Board formally inform Mr. Peabody that he must remove all debris in the spillway section, remove the 8" x 10" timbered flashboard from the spillway, and remove the section of timbered barrier planking above the spillway invert elevation.

Flow from the dam was not an abnormally large flow, as very little water was discharging from the spillway section.

dmr/js

MEMORANDUM

June 6, 1968

To: Vernon A. Knowlton, Water Resources Engineer

From: Robert W. Livingston, Civil Engineer

Subject: Swains Lake - Barrington - Dam #15.02

I inspected the dam at Swains Lake on May 31, 1968. The earthen embankment appears to be in good condition with little leakage visible on the downstream side. However, this dike is overgrown with trees and there is some evidence that camping is planned on, or very near, the embankment. In fact, a small shack which appears to be used for an out-house has been added on new fill at the downstream edge of the dam. I think that this development should be discouraged to insure the future structural stability of the dam.

The spillway of cut stones seems in good shape although the lower board perhaps needs replacing because of its deteriorated condition. The gate was not inspected since the gate house was locked at the time of my inspection.

Fallen trees and other debris should be cleared from the downstream channel.

June 6, 1968

Mr. Myron Peabody  
Hall Road  
Barrington, New Hampshire

Dear Mr. Peabody:

At the request of the Town of Barrington Selectmen, the New Hampshire Water Resources Board inspected your dam on Swaint Lake in Barrington on May 31, 1968. Although this dam is quite old, the general condition is fairly good. No bad leakage was visible at the time one of our staff engineers made the inspection.

The spillway itself appears in good shape although the bottom board will need replacing in the near future. Since the gate house was locked, the gate mechanism was not inspected. In order to pass the 100 year flood flow used as standard by this Board, it is necessary for the boards to be out and the 4' x 4' gate be functional.

It is the opinion of the Water Resources Board that no camp construction should be undertaken on the embankment of the dam. Future structural stability of the dam would be endangered by any such development on the dam itself.

Fallen trees and other debris should be cleared from the downstream channel to permit passage of high flows.

We would appreciate a report from you regarding the operational condition of the gate. If you have any questions or if we may be of technical assistance to you, please contact us.

Very truly yours,

Vernon A. Knowlton,  
Water Resources Engineer

WAK/ac

c.c.-Barrington Board of Selectmen

# NEW HAMPSHIRE WATER CONTROL COMMISSION

## REPORT ON DAM INSPECTION

TOWN Barrington DAM NO. 15.02 STREAM Bellamy River  
OWNER Myra Peabody ADDRESS Hill Rd - Barrington

In accordance with Section 20 of Chapter 133, Laws of 1937, the above dam was inspected by me on ~~March 15, 1961~~ accompanied by \_\_\_\_\_

### NOTES ON PHYSICAL CONDITION

The Abutments - violin with ties both sides of spillway. Recently used for camping on dike. Generally in good shape structurally, no bad leakage.

Spillway Structure is O.K., slight leakage at bottom of downstream stairs. Bottom flushboard (actually steps) is rotting, probably should be replaced.

Gates Not inspected at this time.

Other See

CHANGES SINCE LAST INSPECTION None

### FUTURE INSPECTIONS

This dam (is) (~~is not~~) a menace because of highway downstream & head

REMARKS Debris downstream should be removed from channel.  
Development with possible excavation should be stopped on dike itself.

Copy to Owner	Date

Robert W. Livingston  
INSPECTOR

(Additional Notes Over)

# NEW HAMPSHIRE WATER CONTROL COMMISSION

## REPORT ON DAM INSPECTION

TOWN Barrington DAM NO. 1511 STREAM Fallamy River

OWNER Barrett's Water Mill ADDRESS Barrett's Mill

In accordance with Section 20 of Chapter 133, Laws of 1937, the above dam was inspected by me on Aug 11, 1955 accompanied by John J. Moore

### NOTES ON PHYSICAL CONDITION

Abutments

Good

Spillway

Fair - 15' x 15' of rockwork on - looks badly  
Let water up to top of rockwork

Gates

Apparently operable

Embankment

Other

Good

### CHANGES SINCE LAST INSPECTION

Installed four 36" PC pipe culvert  
1.5' x 1.5' - since last inspection (3' x 3' culvert)  
Some work done on spillway (upstream of P.Dam)  
Also, a culvert installed on left side of dam at H. abut. of spillway

### FUTURE INSPECTIONS

Yes

This dam (is) ~~(is not)~~ a menace because of location above highway

### REMARKS

Water about 1.25' above spillway crest

Up! Ruins of some masonry earth filled dam 150' from highway -  
no walls

Small culvert dam - 14' x 18" culvert  
1.5' high - 1.5' wide - 1.5' deep - 1.5' long

Copy to Owner	Date

John J. Moore  
INSPECTOR

(Additional Notes Over)

# NEW HAMPSHIRE WATER CONTROL COMMISSION

## REPORT ON DAM INSPECTION

TOWN BARRINGTON DAM NO. 15.02 STREAM Bellamy River  
 OWNER American Woolen Co. ADDRESS Dover, N. H.

In accordance with Section 20 of Chapter 133, Laws of 1937, the above dam was inspected by me on March 1, 1940 accompanied by \_\_\_\_\_

### NOTES ON PHYSICAL CONDITION

Abutments Fail - No leaks

Spillway Fail - Stone work in main section approx. 100 ft. long in place water at top of spillway

Gates operable - Some leakage - evidently planking and guides in poor shape. Could not get into gate house for close examination

Other \_\_\_\_\_

### CHANGES SINCE LAST INSPECTION

### FUTURE INSPECTIONS

This dam (is) (~~is not~~) a menace because location alone

### REMARKS

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (Stone curbst)

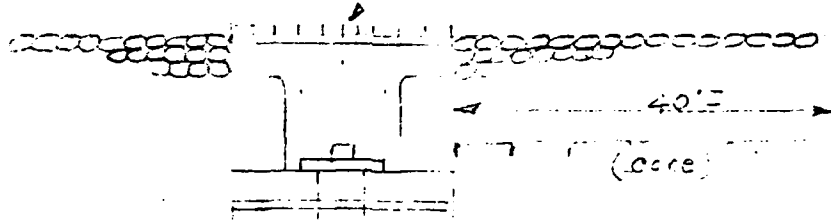
Copy to Owner	Date

C. D. Chubb  
 INSPECTOR

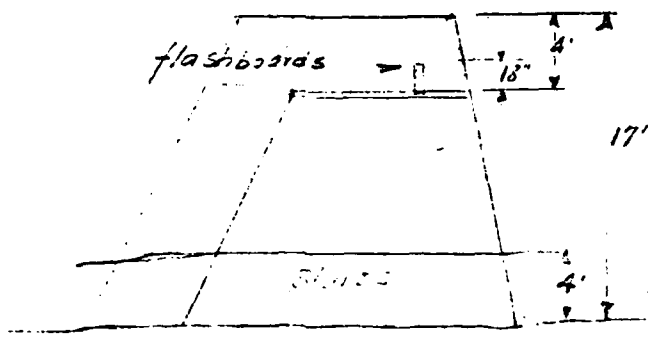
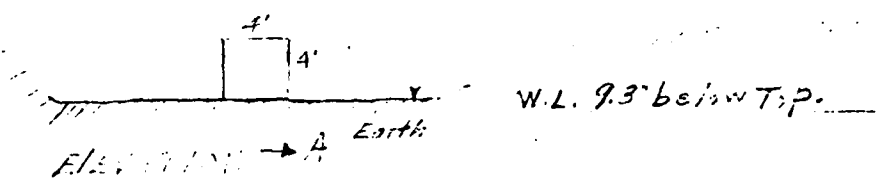
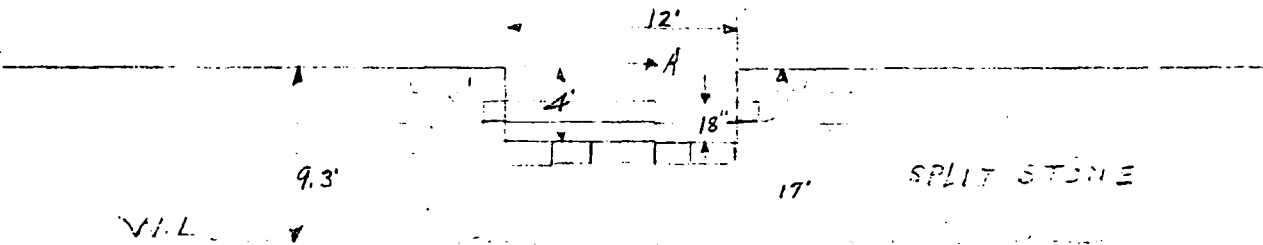
HAMPSHIRE PROJECT \_\_\_\_\_ FILE 15.02  
 R RESOURCES SUBJECT DRAINAGE POND BARRINGTON ACC \_\_\_\_\_  
 BOARD S. AN. BELLAMY/REDA AMERICAN HOLDEN CO.  
 ORD. N. H. COMPUTER G. SM. CHECKER R. L. I. CONT. FROM ACC. CONT. ON ACC. SUMMARY ON ACC. DATE ~~\_\_\_\_\_~~

100' ± 12' 244' ±

— Cofferdam.



PLAN scale 1" = 10'-0"



SECTION A-A

B - 25  
Date



**NEW HAMPSHIRE WATER CONTROL COMMISSION  
DATA ON RESERVOIRS & PONDS IN NEW HAMPSHIRE**

**LOCATION** AT DAM NO. 15.92  
 Town Stratford : County Stratford  
 Stream S. Pine Pond  
 Basin—Primary S. Pine Pond : Secondary Ballantyne R.  
 Local Name .....

**DRAINAGE AREA**

Controlled ..... Sq. Mi.: Uncontrolled ..... Sq. Mi.: Total ..... Sq. Mi.

**ELEVATION vs. WATER SURFACE AREA vs. VOLUME**

Point	Head Feet	Surface Area Acres	Volume Acres Ft.
(1) Max. Flood Height .....	.....	.....	.....
(2) Top of Flashboards .....	.....	<u>421</u>	.....
(3) Permanent Crest .....	.....	.....	.....
(4) Normal Drawdown .....	.....	.....	.....
(5) Max. Drawdown .....	.....	.....	.....
(6) Original Pond <u>U.S.G.S. G.L.</u> .....	.....	.....	.....

Base Used .....: Coef. to change to U.S.G.S. Base .....

**RESERVOIR CAPACITY**

	Total Volume	Useable Volume
Drawdown .....	.....ft.	.....ft.
Volume .....	.....ac. ft.	.....ac. ft.
Acre ft. per sq. mi. ....	.....	.....
Inches per sq. mi. ....	.....	.....

**USE OF WATER** Storage Conservation

**OWNER** American Woolen Co. Strayer Realty - Dodge

**REMARKS** Condition Fair Stockland

Inspection By A. J. & B. L. T. B - 26 Date October 17, 1954

15.07 Barrington Dam - Barrington  
Stream, N.H.

PUBLIC SERVICE COMMISSION OF NEW HAMPSHIRE—DAM RECORD

I-4786

TOWN	Barrington	TOWN NO.	2	STATE NO.	15.02
RIVER STREAM	<del>Swains Pond</del> <i>Barrington River</i>				
DRAINAGE AREA	5.5 S. 1. N. 6.		POND AREA		
DAM TYPE	Gravity		FOUNDATION NATURE OF	Earth	
MATERIALS OF CONSTRUCTION	Earth, Boulders, Split Stone				
PURPOSE OF DAM	POWER— <del>CONSERVATION</del> —DOMESTIC—RECREATION—TRANSPORTION—PUBLIC UTILITY				
HEIGHTS TOP OF DAM TO BED OF STREAM	17'		TOP OF DAM TO SPILLWAY CRESTS	4'	
SPILLWAYS, LENGTHS DEPTHS BELOW TOP OF DAM	12'		LENGTH OF DAM <i>Approx. 420'</i>		
FLASHBOARDS TYPE, HEIGHT ABOVE CREST	Fixed 18"				
OPERATING HEAD CREST TO N. T. W.			TOP OF FLASHBOARDS TO N. T. W.		
WHEELS, NUMBER KINDS & H. P.					
GENERATORS, NUMBER KINDS & H. P.					
H. P. 90 P. C. TIME 100 P. C. EFF.			H. P. 75 P. C. TIME 100 P. C. EFF.		
REFERENCES, CASES, LAWS, INSPECTIONS.					

REMARKS

OWNER- American Woolen Company *Swyer Realty - Dover*  
*Stockland*  
CONDITION- Fair  
REPLACE- Yes. Will be subject to periodic inspection.

To the Public Service Commission:

The foregoing memorandum on the above dam is submitted covering inspection made September 26, 1935, according to notification to owner dated September 24, 1935, and bill for same is enclosed.

Samuel J. Lord  
Hyd. Eng.

Copy to Owner

(2)

NEW HAMPSHIRE WATER RESOURCES BOARD  
INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Canaan NO. 1000 State St. 100-2-4786  
RIVER Canal MILES FROM MOUTH D.A.-30 MI. 5.5  
TOWN Canaan OWNER American Water Works Co. N.H.  
LOCAL NAME OF DAM \_\_\_\_\_  
BUILT \_\_\_\_\_ DESCRIPTION Gravity - embankment, stone masonry

POND AREA - ACRES 420.48 DRAWDOWN - FT. \_\_\_\_\_ POND CAPACITY - ACRES FT. \_\_\_\_\_  
HEIGHT - GREST TO BED OF STREAM - FT. 17 MAX. ANCHOR MIN. \_\_\_\_\_  
OVERALL LENGTH OF DAM - FT. 420 MAX. FLOOD HEIGHT ABOVE GREST - FT. \_\_\_\_\_  
PERMANENT CREST ELEV. U.S.C.S. \_\_\_\_\_ LOCAL GAGE \_\_\_\_\_  
TAILWATER ELEV. U.S.C.S. \_\_\_\_\_ LOCAL GAGE \_\_\_\_\_  
SPILLWAY LENGTH - FT. 12 FRESHWATER \_\_\_\_\_  
FLASHBOGLOS TYPE, HEIGHT ABOVE GREST 1.5 ft. 1951  
GATE GATES - NO. \_\_\_\_\_ WIDTH MAX. OPENING \_\_\_\_\_ DEPTH SILL BELOW CREST \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

REMARKS Condition Fair

11  
\_\_\_\_\_  
\_\_\_\_\_

POWER DEVELOPMENT

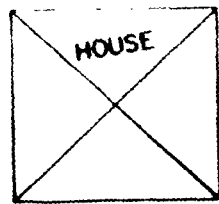
UNITS	NO.	RATED HP.	HEAD FEET	C.F.S. FULL GATE	KW.	MAKE
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

USE Conservation

REMARKS \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

DATE 9/26/35

REPRODUCED AT GOVERNMENT EXPENSE



GATE HOUSING

UNION LAKE

PLA

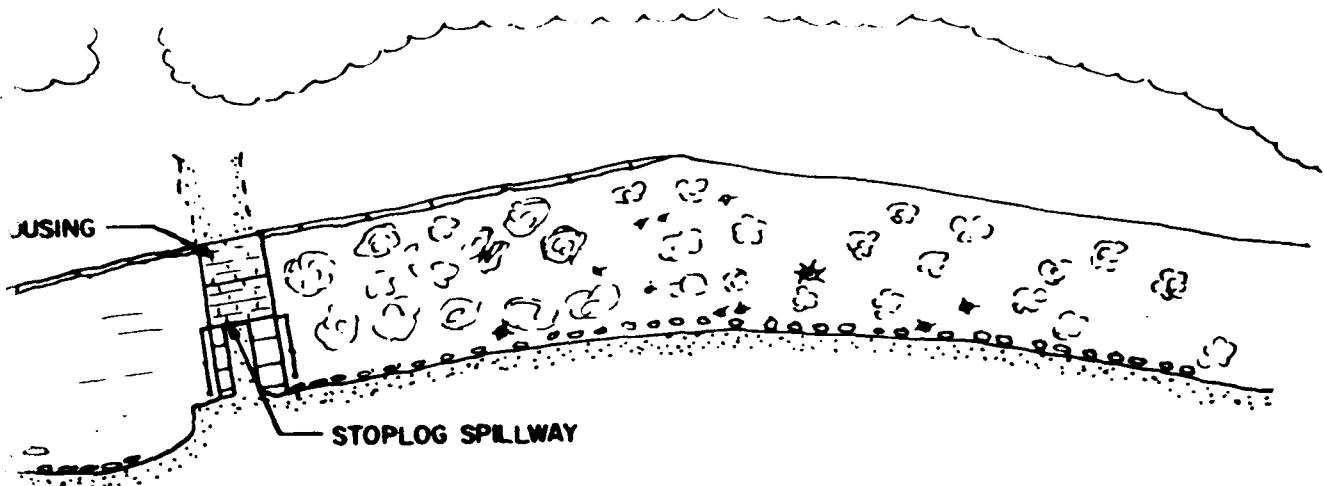
TREES

ROAD

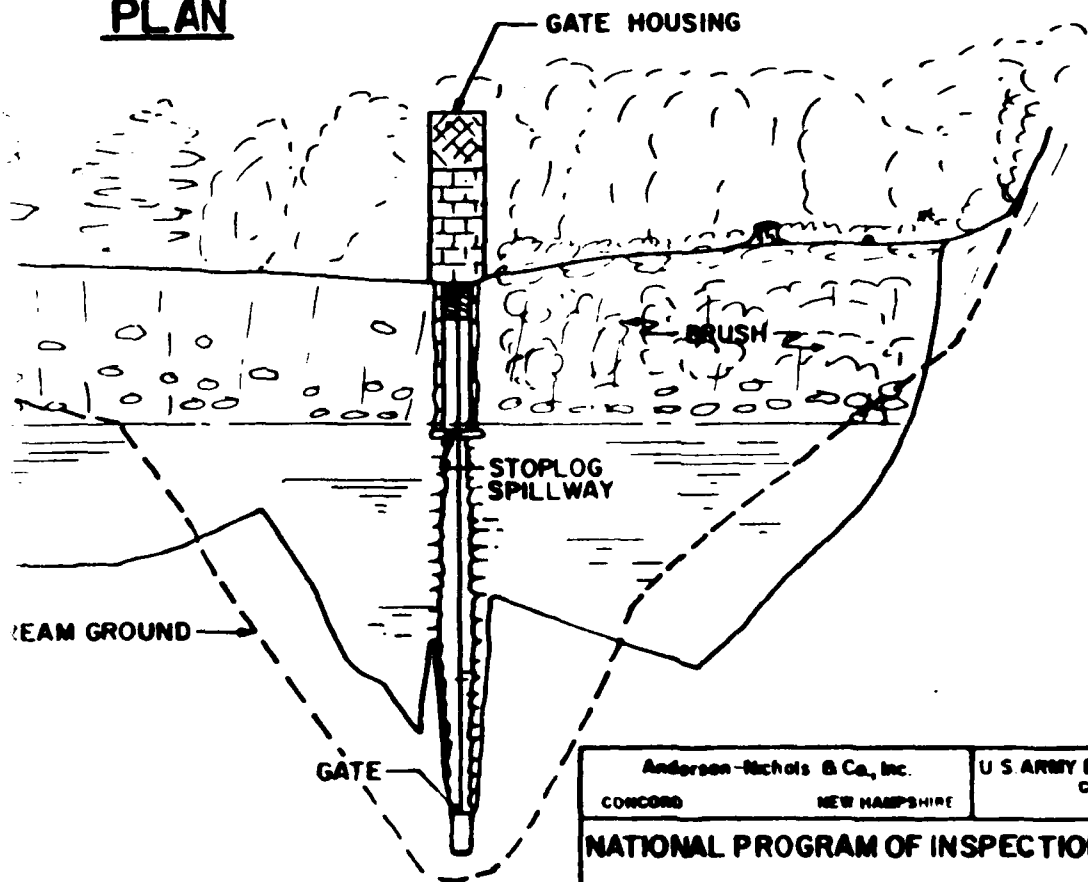
UPSTREAM GROUND

DOWNSTREAM GROUND

ELEVA

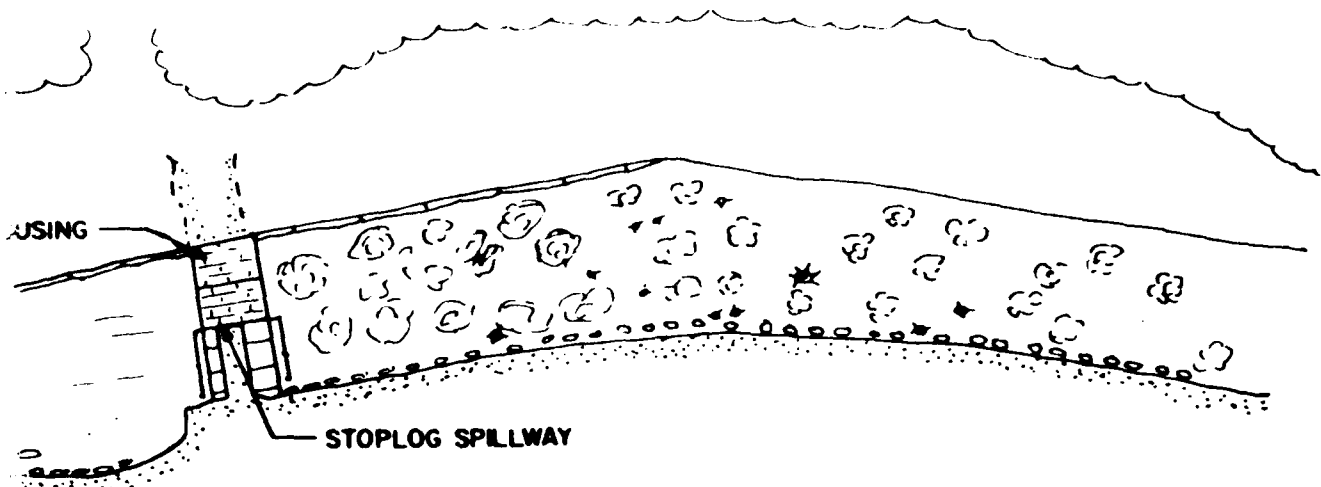


**PLAN**

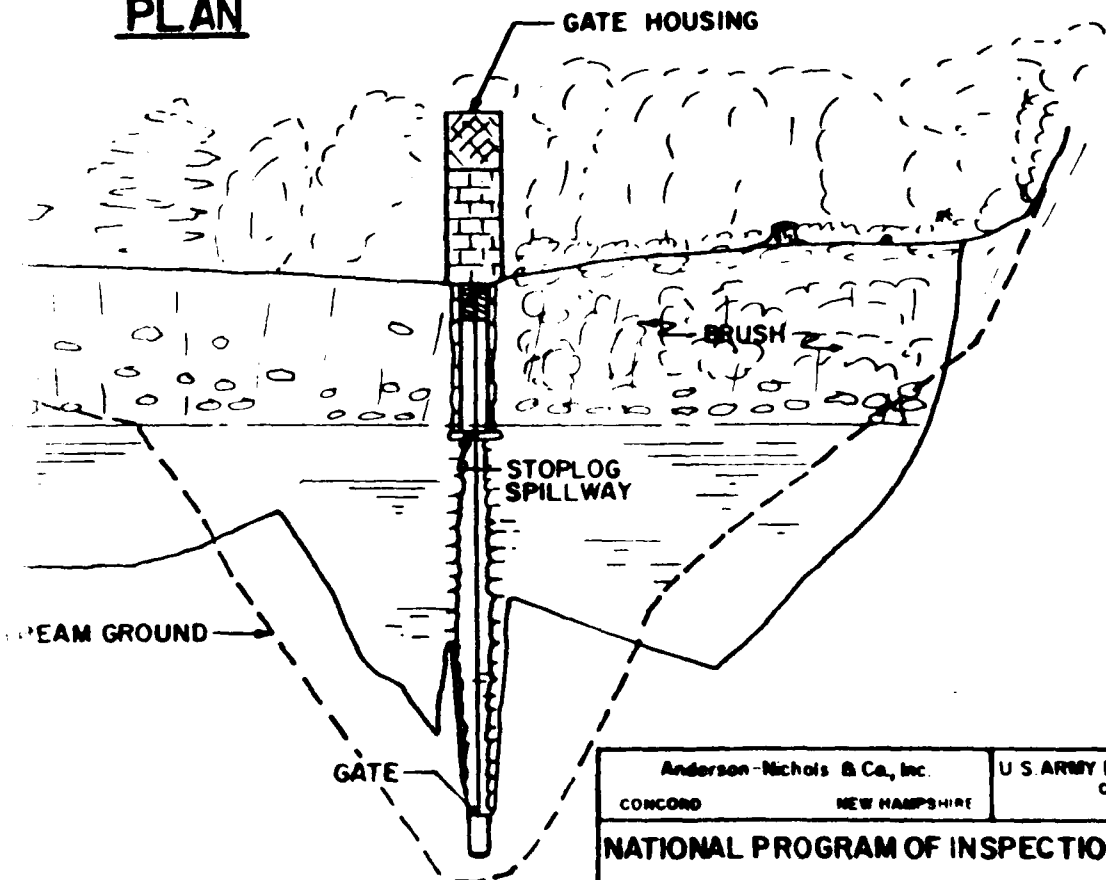


**ELEVATION**

Anderson-Nichols & Co., Inc.		U S ARMY ENGINEER DIV. NEW ENGLAND	
CONCORD		CORPS OF ENGINEERS	
NEW HAMPSHIRE		WALTHAM, MASS.	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
UNION LAKE DAM			
UNION LAKE		NEW HAMPSHIRE	
		SCALE NOT TO SCALE	
		DATE AUGUST 1978	

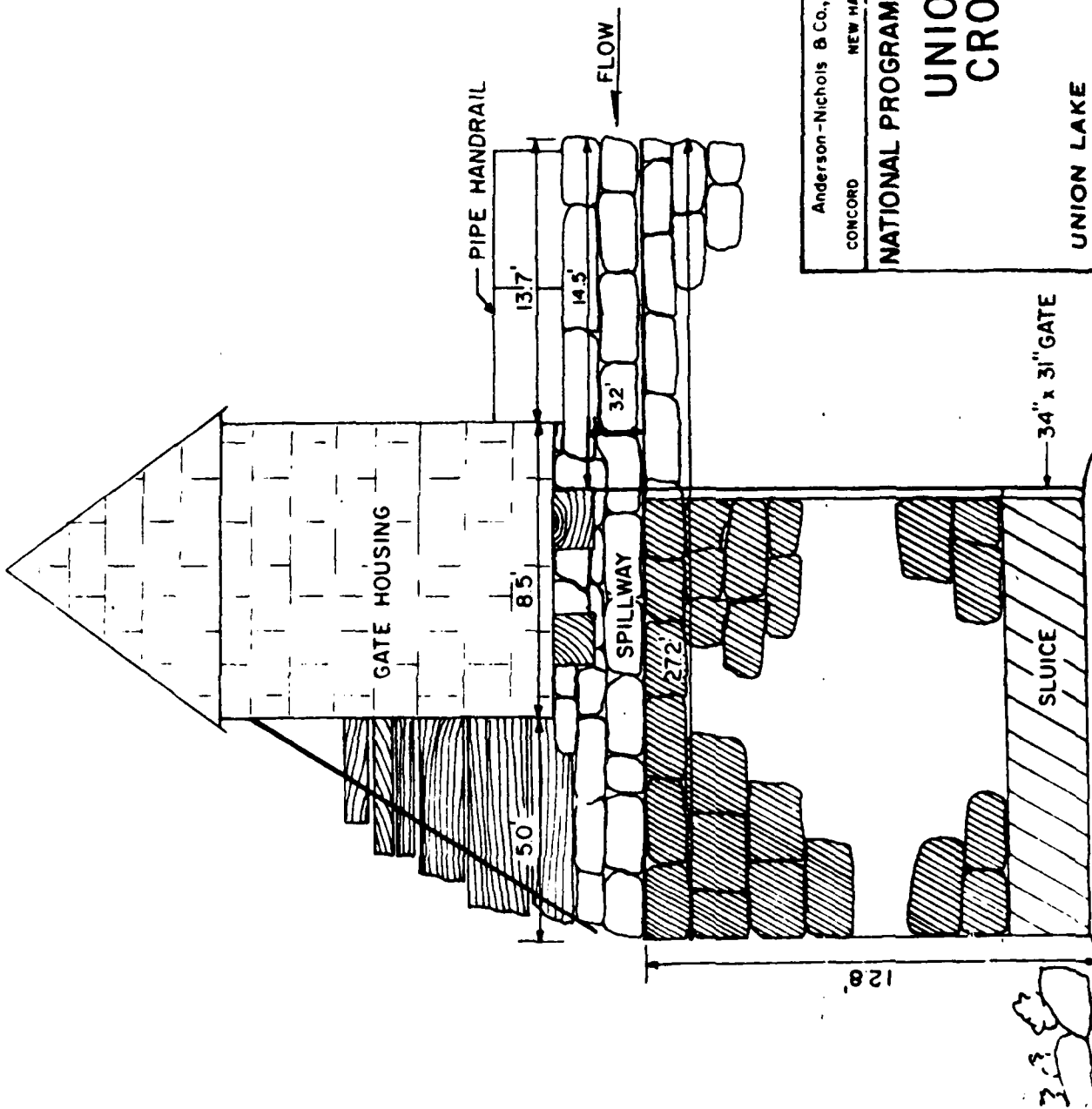


**PLAN**

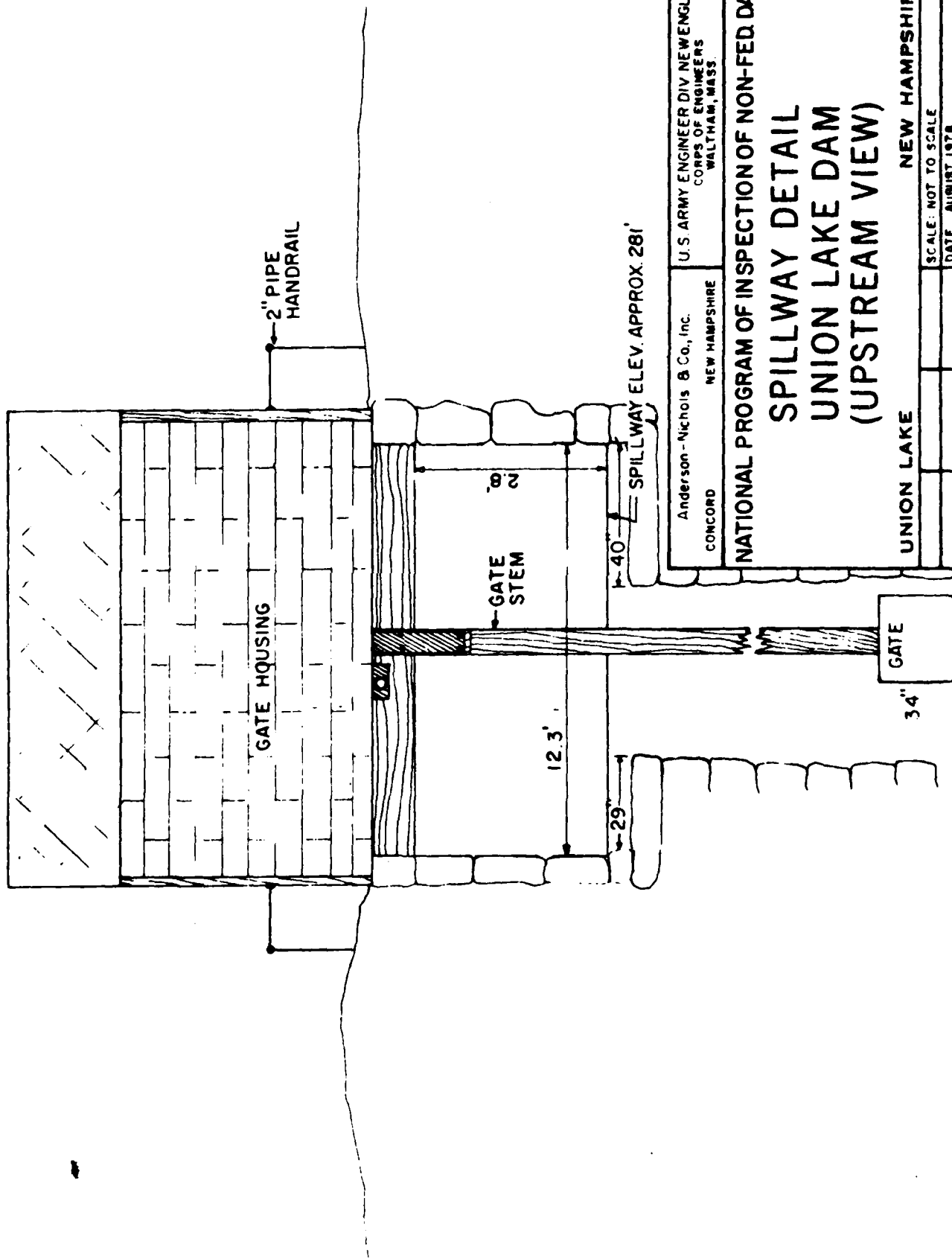


**ELEVATION**

Anderson-Nichols & Co., Inc.		U S ARMY ENGINEER DIV. NEW ENGLAND	
CONCORD		CORPS OF ENGINEERS	
NEW HAMPSHIRE		BALTIMORE, MARY.	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
UNION LAKE DAM			
UNION LAKE		NEW HAMPSHIRE	
		SCALE NOT TO SCALE	
		DATE AUGUST 1978	



Anderson-Nichols & Co., Inc. CONCORD	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	
UNION LAKE DAM CROSS-SECTION	
UNION LAKE	NEW HAMPSHIRE
SCALE: NOT TO SCALE	
DATE: AUGUST 1978	



Anderson-Nichols & Co., Inc.  
CONCORD NEW HAMPSHIRE

U.S. ARMY ENGINEER DIV NEW ENGLAND  
CORPS OF ENGINEERS  
WALTHAM, MASS.

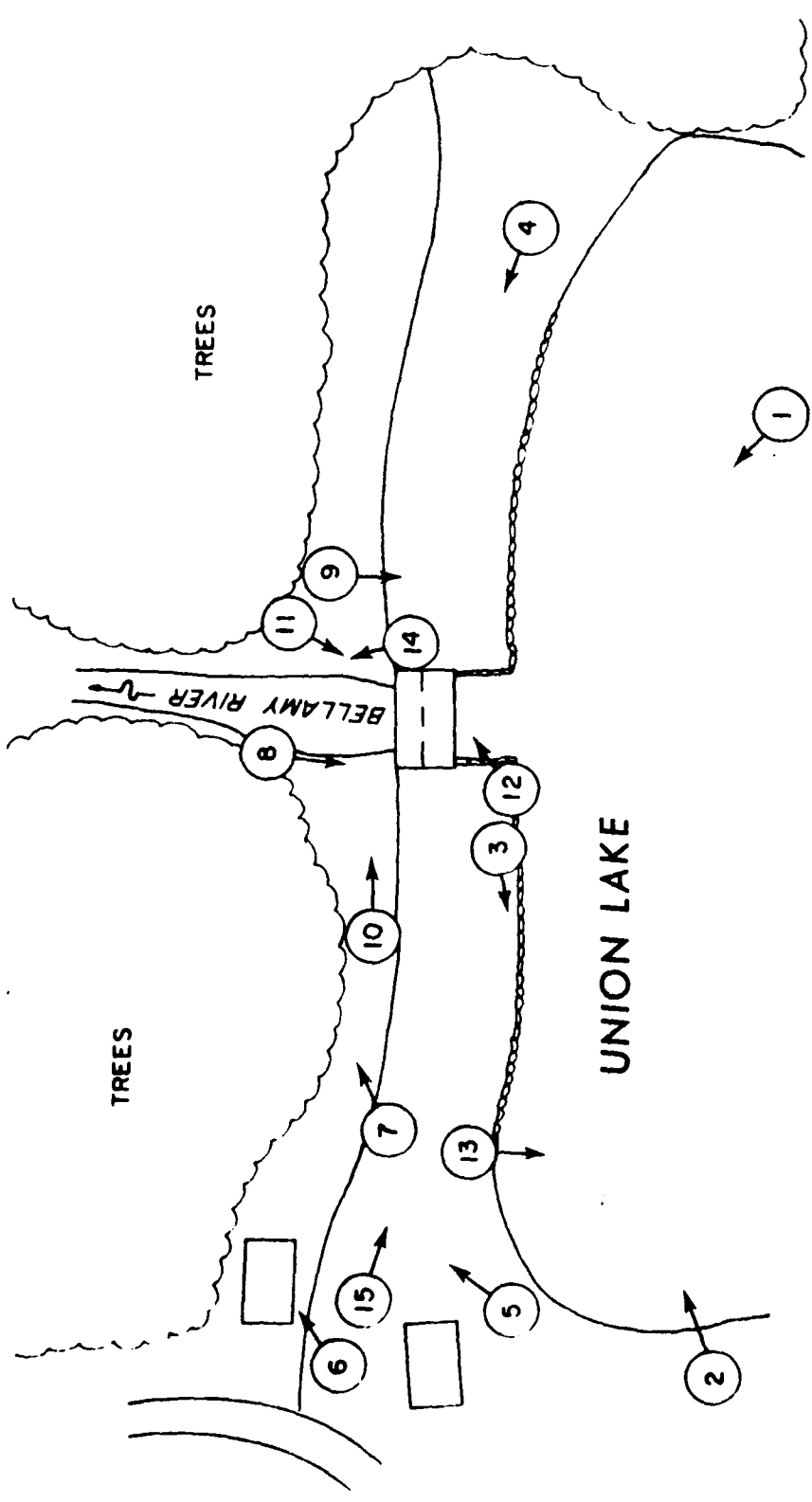
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

SPILLWAY DETAIL  
UNION LAKE DAM  
(UPSTREAM VIEW)

UNION LAKE	NEW HAMPSHIRE
SCALE: NOT TO SCALE	DATE: AUGUST 1978



APPENDIX C  
PHOTOGRAPHS



Anderson-Nichols & Co., Inc. CONCORD	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS	
UNION LAKE DAM PHOTO INDEX	
UNION LAKE	NEW HAMPSHIRE
	SCALE: NOT TO SCALE
	DATE: AUGUST 1979



Figure 2 - Looking towards the gatehouse from the north side of the reservoir.



Figure 3 - Closeup of random fill placed on the upstream slope north of the outlet showing inadequacy of vegetative cover to prevent erosion.



Figure 4 - Looking along the center of the embankment towards the gatehouse from the south abutment. Note brush growing near upstream and downstream faces.



Figure 5 - Looking at the beach which forms the upstream face of the dam near the north abutment.



Figure 6 - Closeup of house trailer located on north abutment.



Figure 7 - View looking southeast from the crest of the dam showing the area downstream of the dam on the north side of the valley.



Figure 8 - A pile of sand and gravel at the toe of the downstream dry masonry wall on the north side of the outlet channel.

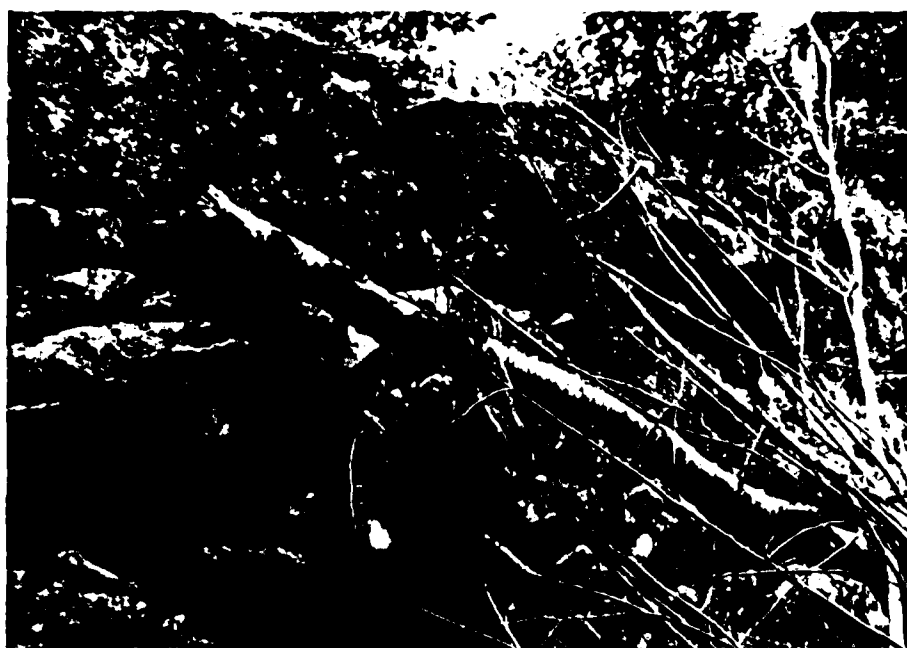


Figure 9 - View of a tree stump in the downstream face of the dam, about 50 feet south of the spillway.



Figure 10 - Looking along the downstream face of the dam.



Figure 11 - Looking upstream at the spillway and gatehouse.



Figure 12 - Looking at the stoplog spillway and the upstream face of the gatehouse and gate lifting mechanism.



Figure 13 - Looking upstream at the reservoir from the north end of the embankment.



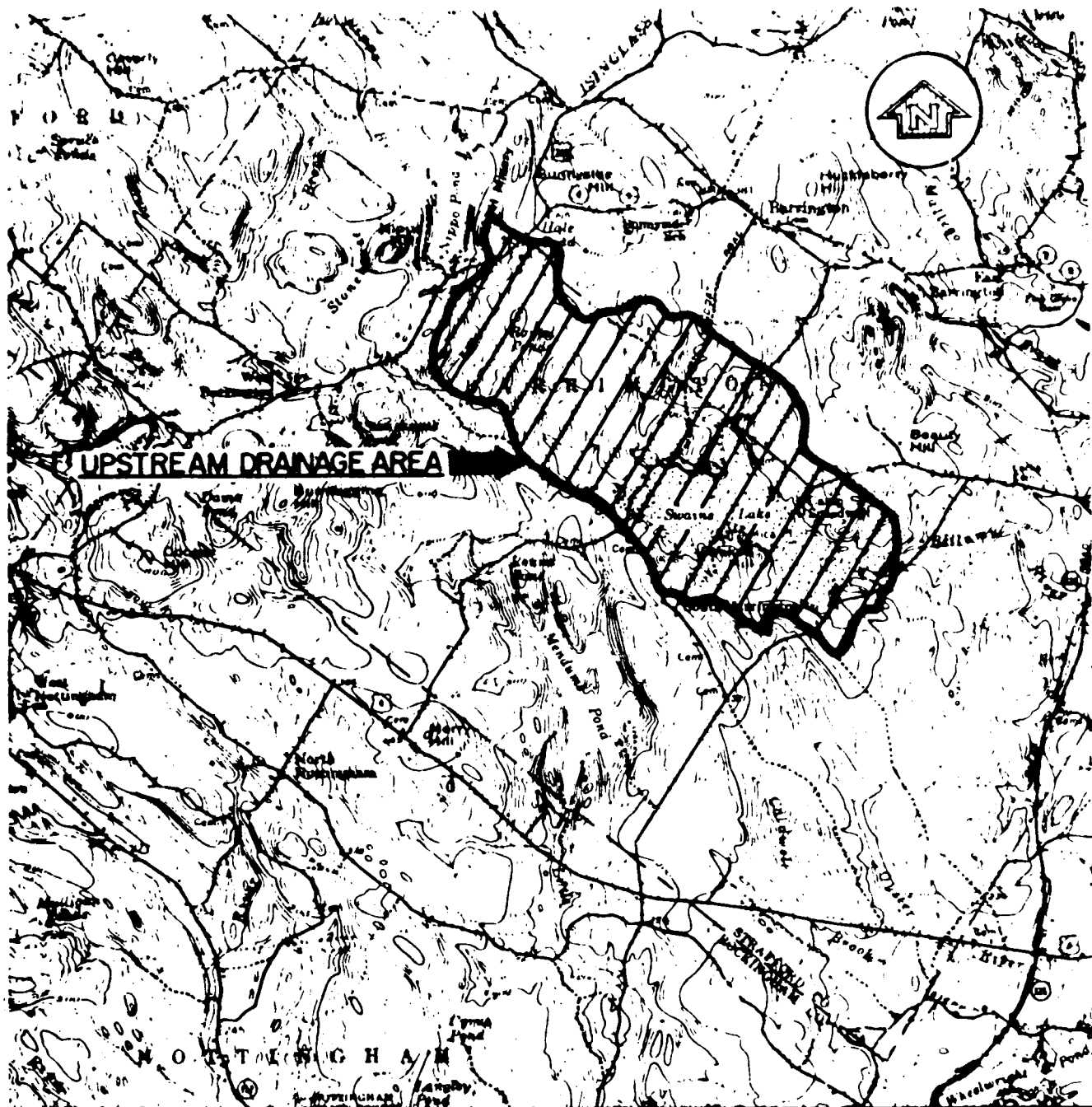


Figure 14 - View of the outlet channel from the top of the dam. Note the debris.



Figure 15 - Looking across the crest of the dam from the north abutment.

APPENDIX D  
HYDROLOGY/HYDRAULICS



NATIONAL PROGRAM OF INSPECTION OF  
NON-FED. DAMS

UNION LAKE DAM

BARRINGTON, NEW HAMPSHIRE  
REGIONAL VICINITY MAP

AUGUST 1978

DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
WALTHAM, MASSACHUSETTS

ANDERSON NICHOLS & CO., INC.

CONC. (XRD), NH

SCALE IN MILES



MAP BASED ON USGS 15 MINUTE QUADRANGLE  
SHEET Mt. PAWTUCKAWAY, N.H. 1957.

JOB NO. 3141-08 (Swains Pond) Dam  
Union Lake

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

DA = 4.01 mi<sup>2</sup>

Size Classification = Intermediate

Hazard Classification = Significant

Inspection Flood = 1/2 PMF to PMF

Step #1

Calculate PMF using "Preliminary Guidance For  
 Estimating Maximum Probable Discharges" in  
 Phase I Dam Safety Investigations, March 1978

Use Flat & Coastal

@ 4.01 mi<sup>2</sup> P.M.F. in cfs/mi<sup>2</sup> = 845

P.M.F. for Swains Pond is:

845 cfs/mi<sup>2</sup> x 4.01 mi<sup>2</sup> = 3388 cfs

PEAK INFLOW = 3390 cfs

Assume:

C value = 2.64

Gate closed

Normal Pool & Spillway @ Elev. 281 as shown  
 on Quad Sheet. Normal Storage = 2000 ac-ft

DA = 4.01 mi<sup>2</sup>

Surface Area @ 281 - 405 acres

Surface Area @ 300 - 760 acres

@ 283.8' MSL Low Ch. @

Q spillway = 2.64 (12.3) (2.8)<sup>3/2</sup>  
 = 153 cfs

JOB NO. \_\_\_\_\_

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

Step # 2a:

Determine anchorage height to Pass "Qp."  
 of 3390 cfs.

Trial #1 Assume elevation of 285.2' MSL  
 (low pt. before ovetop)

$$Q_{\text{spillway}} = CA \sqrt{2gh}$$

$$= (0.80)(34.44)(\sqrt{2(32.2 \times 2.8)})$$

$$= \underline{370 \text{ cfs}}$$

Trial #2 Assume elevation of 286' MSL

$$Q_{\text{spillway}} = (0.80)(34.44)(\sqrt{2(32.2 \times 4)})$$

$$= 442 \text{ cfs}$$

$$Q_{\text{weir}} = 2.7(\frac{1}{2}154)(0.9)^{3/2} + 2.7(\frac{1}{2}54)(0.8)^{3/2}$$

$$= 178 + 52 = 230$$

$$\text{Tot } Q = \underline{672 \text{ cfs}}$$

Trial #3 Assume elevation of 287' MSL

$$Q_{\text{spillway}} = (0.80)(34.44)(\sqrt{2(32.2 \times 5)})$$

$$= 494 \text{ cfs}$$

$$Q_{\text{weir}} = 2.7(\frac{1}{2}60)(1.0)^{3/2} + 2.7(\frac{1}{2}80)(1.0)^{3/2} +$$

$$2.7(\frac{1}{2}45)(1.0)^{3/2} + 2.7(\frac{1}{2}55)(1.0)^{3/2} + 2.7(\frac{1}{2}154)(0.9)^{3/2} +$$

$$2.7(\frac{1}{2}84)(1.8)^{3/2} + 2.7(\frac{1}{2}50)(1.0)^{3/2} + 2.7(\frac{1}{2}20)(1.7)^{3/2} + 2.7(\frac{1}{2}$$

$$= 81 + 108 + 61 + 149 + 416 + 176 +$$

$$274 + 135 + 16 + 40 = 1456$$

$$\text{Tot } Q = \underline{1950 \text{ cfs}}$$

Trial #4 Assume elevation of 288' MSL

$$Q_{\text{spillway}} = (0.80)(34.44)(\sqrt{2(32.2 \times 6)}) = 54$$

$$Q_{\text{weir}} = 2.7(\frac{1}{2}96)(2.0)^{3/2} + 2.7(\frac{1}{2}160)(2.0)^{3/2} + 2.7(\frac{1}{2}65$$

$$2.7(\frac{1}{2}174)(2.0)^{3/2} + 2.7(\frac{1}{2}174)(0.9)^{3/2} + 2.7(\frac{1}{2}1$$

$$2.7(\frac{1}{2}10)(1.7)^{3/2} + 2.7(\frac{1}{2}25)(1.2)^{3/2}$$

$$= 367 + 61 + 496 + 1329 + 200 + 802 +$$

$$= 4193 \quad \text{Tot } Q = \underline{4735 \text{ cfs}}$$

JOB NO. 3141-08 (Swains Pond) Dam  
Union Lake

Date 7/25/78

Computed

Checked

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Use trials to establish rating curve.

Read discharge of 3390 @ ELEV. 287.4

Step #2 b.

Determine Volume of Surcharge in Inches  
of Runoff

Normal Ac-FT Storage = 2000 AC-FT

Surface Area = 405 ACRES

Normal Pool @ 281.

'Frustrum of Pyramid'

$$V = \frac{1}{3} h \left( b_1 + b_2 + \sqrt{b_1 b_2} \right)$$

(elev. above normal pool)

(enlarged surface area in acres  
normal pool surface area in acres)

@ Elev. 300

Surface area = 760 acres

$$V = \frac{1}{3} 19 (405 + 760 + \sqrt{405 \times 760})$$

$$= \frac{1}{3} 19 (1165 + 554.8)$$

$$= 10890 \text{ AC-FT}$$

Maximum Storage - Inventory Sheet

@ 285.2 = 2400 AC-FT

Use above data to obtain Storage -  
Elevation Curve.

$$V = \frac{1}{3} 4.2 (405 + 500 + \sqrt{405 \times 500})$$

$$= \frac{1}{3} 4.2 (905 + 450)$$

$$= 1897 \text{ AC-FT}$$

@ 285.2 - Storage of 2000 + 1900 = 3900 AF  
is a more reasonable number to reflect  
the significant amount of storage available  
before overtopping.

JOB NO. \_\_\_\_\_

S 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30  
CA

Zb

Surcharge Height to pass  $Q_p' - 287.4$   
 Volume of storage can be read now from  
 storage elevation curve.  
 Curve  $\rightarrow 4900$  AC-FT

$$2900 \text{ AF} \times \frac{1}{4.01 \text{ mi}^2} \times \frac{1 \text{ mi}^2}{640 \text{ Acres}} = 1.13'$$

$$1.13' \times 12 \frac{\text{in}}{\text{ft}} = 13.56'' \text{ of runoff}$$

Zc

$$Q_{p2} = Q_{p1} \times \left(1 - \frac{\text{STOR } 1}{19''}\right)$$

$$= 3390 \text{ cfs} \left(1 - \frac{13.56''}{19''}\right)$$

$$= 3390 \text{ cfs} \times 0.29$$

$$= 971 \text{ cfs}$$

3a Determine surcharge height to pass  $Q_{p2}$  of  
 971 cfs

Refer to Rating Curve:

@ 971 cfs the elev. of 286.5' MSL

Refer to Storage vs Elevation Curve:

@ 286.5' a volume of 4540 ac-ft

$$2540 \text{ AF} \times \frac{1}{4.01 \text{ mi}^2} \times \frac{1 \text{ mi}^2}{640 \text{ Acres}} = 0.95'$$

$$0.95' \times 12 \frac{\text{in}}{\text{ft}} = 11.46'' \text{ of runoff}$$

3b

$$\text{STOR } 1 = 13.56''$$

$$\text{STOR } 2 = 11.46''$$

$$\text{Average} = 12.51'' \text{ or } 1.04' \text{ runoff}$$

$$1.04' \times \frac{4.01 \text{ mi}^2}{1} \times \frac{640 \text{ AC}}{\text{mi}^2} = 2675 \text{ ac-ft}$$

Refer to Storage Elevation curve:

with an increase of 2675 ac-ft an  
 elevation of 287 can be read

JOB NO. \_\_\_\_\_

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

@ 287 Refer to Rating Curve :  
@ 287 discharge  $\rightarrow$  1850 cfs

Storage normal = 2000 AC-FT  
Storage maximum = 3900 AC-FT

Surface area @ normal pool (281' MSL) = 405 ac  
Surface area @ maximum pool (285.2' MSL) = 500 ac

@  $\frac{1}{2}$  PMF Discharge of 925 cfs  
Elevation = 286.5

PMF Elev. 287 - Discharge 1850 cfs



# UNION LAKE DAM (SWAINS POND DAM) RATING CURVE

NOTE: 281 - Spillway Crest

DISCHARGE IN CFS

5000

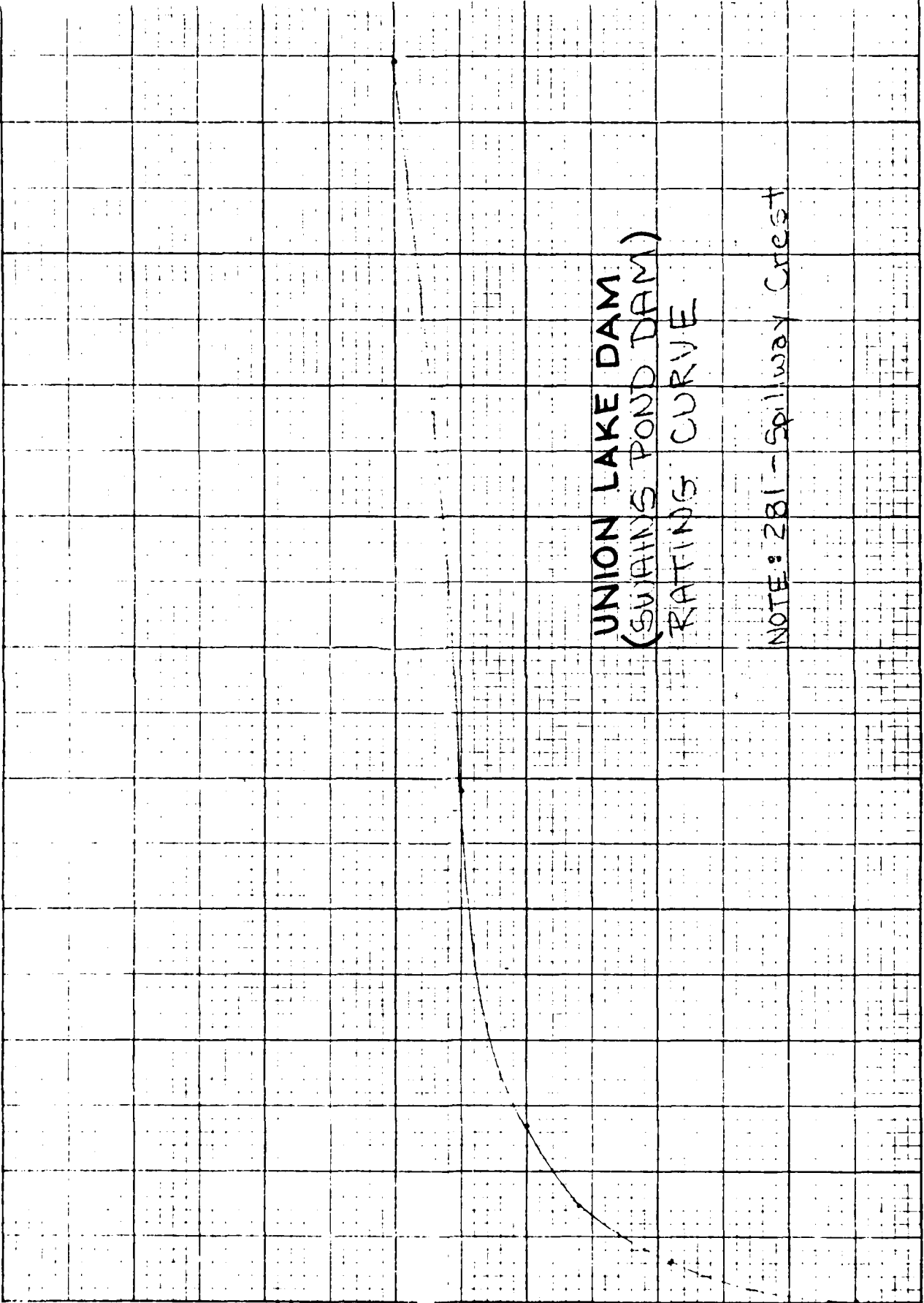
4000

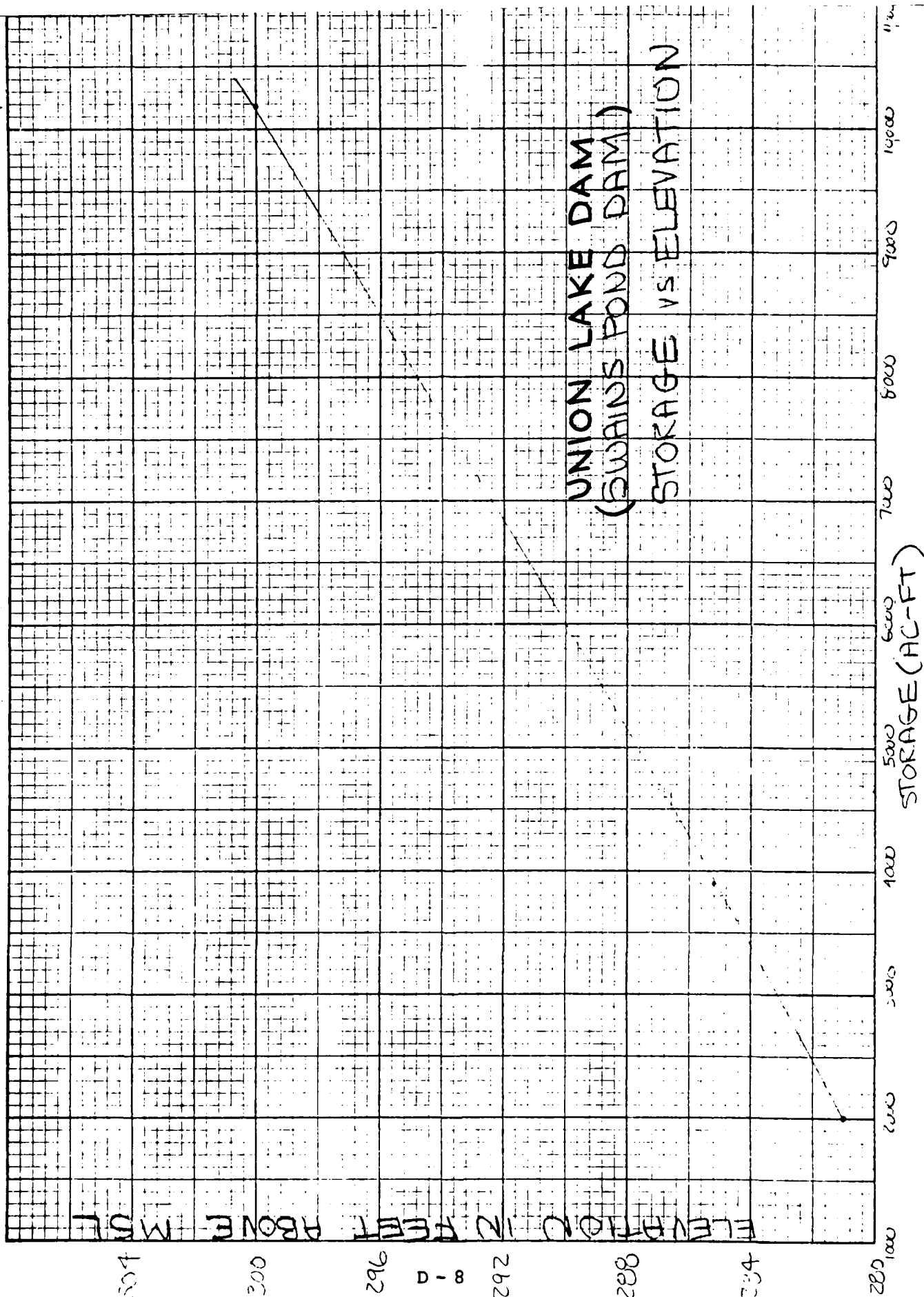
3000

2000

1000

0





JOB NO. \_\_\_\_\_

## (SWAINS POND DAM :) UNION LAKE DAM

BREACH @ maximum pool - 285.2' MSL

Storage @ time of failure - 3900 AF

$$Q_{p1} = \frac{8}{27} W_b \sqrt{g} y_0^{3/2}$$

 $W_b$  = breach width

$$g = 32.2 \text{ ft/sec}^2$$

 $y_0$  = pool elev.  $\rightarrow$  v/s river bed

@ Swains Pond Dam:

$$W_b = 125'$$

$$g = 32.2 \text{ ft/sec}^2$$

$$y_0 = 285.2 - 269.5 = 15.7'$$

From above equation:  $Q = 13,074 \text{ cfs}$ 

Use typical cross section along downstream reach and establish rating curve.

 $Q$  of 13,074 - Stage 14.5'

$$\text{Reach } Q_{p1} = 8976$$

$$\text{Area @ 14.5' stage} = 2900 \text{ AF} = 598 \text{ AF}$$

$$Q_{p2} = 13,074 \left(1 - \frac{598}{3900}\right)$$

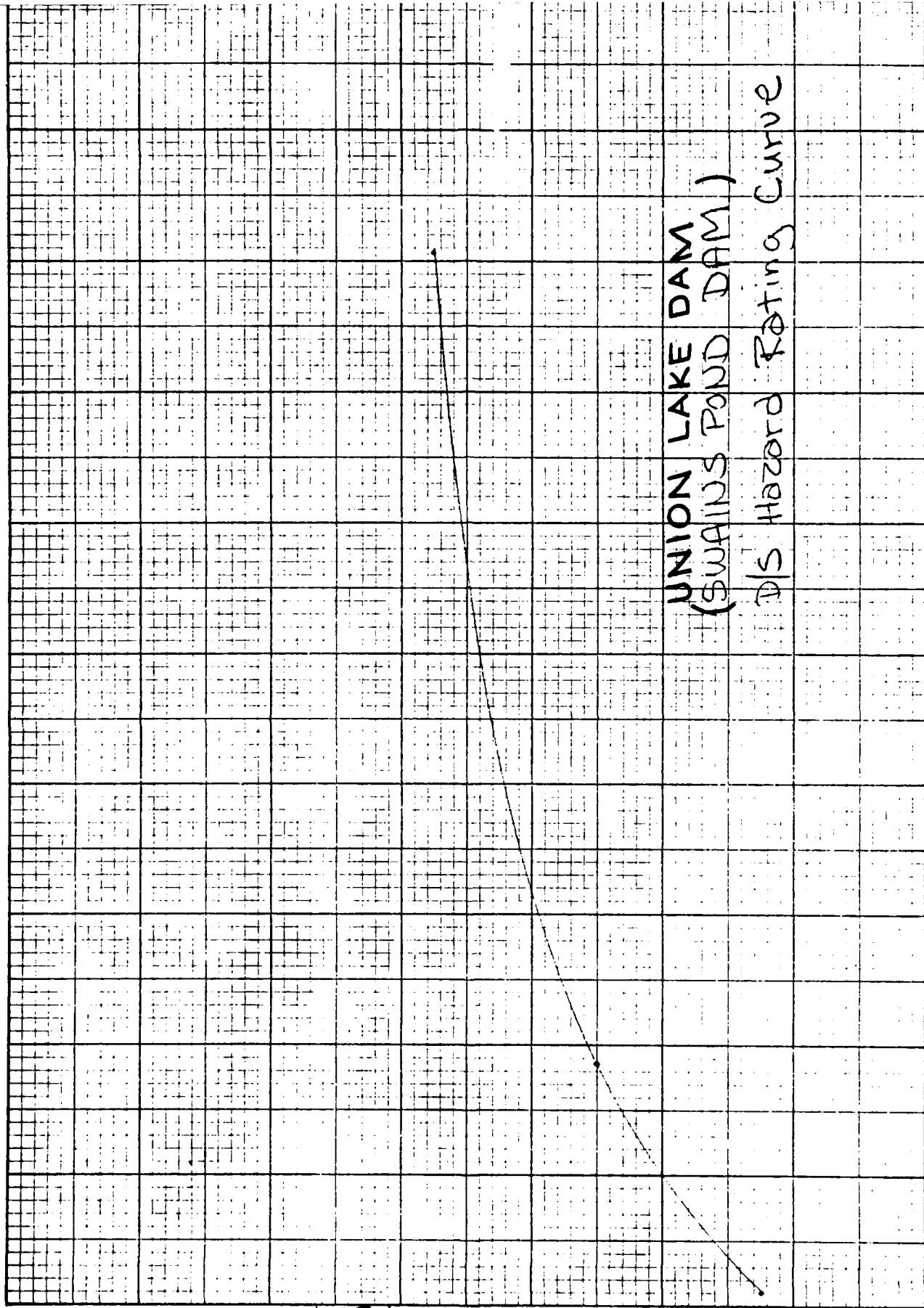
$$= 11,069$$

$$\text{Stage} = 14'$$

Use 14' stage

Antecedent discharge - 370 cfs

 $\therefore$  Increase in stage =  $14 - 5 = 9'$  stage increase



UNION LAKE DAM  
(SWAINS POND DAM)

D/S Hazard Rating Curve

13,000

14,000

10,000

6,000

0

DISCHARGE IN CFS

STAGE HEIGHT IN FEET

12

10

8

Not to Scale

6

4

JOB NO. 341-08 (Union Lake Pond) UnionUnion LakeS 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30  
CAHall Road

-imp 4.5'

40' length

2' HW Available

located just d/s of Hall's Mill Site

Area = 16 ft<sup>2</sup>

$$Q = CA \sqrt{2gh}$$

$$K_f = \frac{29.1(0.24)^{2.48}}{(1.13)^{1/3}}$$

$$= 0.44$$

entrance &amp; exit losses = 1.1

$$\therefore \text{Total} = 1.1 + 0.44 = 1.5$$

$$K = \frac{1}{c^2} \quad 1.5 = \frac{1}{c^2} \quad c = 0.82$$

$$Q = CA \sqrt{2gh}$$

Assume WSEL @ top of road

$$Q = 0.82(16) \sqrt{2(32.2 \times 6.5)}$$

$$Q = 268 \pm \text{cfs}$$

$$c = 0.87$$

$$A = 16$$

$$g = 32.2$$

$$h = 4.5 + 2 = 6.5$$

Assuming this structure provides  
 little storage use 14639 cfs  
 @ Pierce Rd. and Rte 125.

Pierce Road - gravel road

cut stone - double barrel

24' length

2.5' HW available

4' high x 4.5' + 4' high x 4.1'

$$\text{Area} = 34 \text{ ft}^2$$

$$K_f = \frac{29.1(0.03)^{2.48}}{(1.98)^{1/3}}$$

$$= 0.65$$

$$K = \frac{1}{c^2} \quad 1.75 = \frac{1}{c^2} \quad c = 0.76$$

$$\text{entrance \& exit losses} = 1.1 \therefore \text{Total} = 1.75$$

$$Q = CA \sqrt{2gh} \quad \text{Assume WSEL @ top road}$$

$$Q = 0.76(34) \sqrt{2(32.2 \times 6.5)}$$

$$= 529 \pm \text{cfs}$$

JOB NO. 3141-08 (Sump Ponds) Don  
Union Lake

SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

Rte. 125

chip pipe arch

7' high

10' width @ largest point

3.5' HW available

75' length

Area = 54 ft<sup>2</sup>

$$K_f = \frac{29.1(.024)^2}{(2)^{4/3}} \cdot 75$$

$$= 0.50$$

entrance & exit losses = 1.1

$$\therefore \text{Tot} = 1.6$$

$$K = \frac{1}{c^2} \quad 1.6 = \frac{1}{c^2} \quad c = 0.79$$

$$Q = CA \sqrt{2gh}$$

$$= 0.79(54) \sqrt{2(32.2 \times 8.5)}$$

$$= 998 \pm \text{cfs}$$

12/12

# Union Lake (Swains Pond) Dam - Gate Capacity

Calculate approximate gate capacity  
@ spillway crest - 281' MSL

Data: One gate  
31" W x 34" H  
Area = 7.32 ft<sup>2</sup>  
Invert - 269' MSL

$$K_f = \frac{29.1(n^2)L}{R^{4/3}}$$

$$K_f = 0.25$$

$$n = 0.02$$

$$L = 12.7$$

$$R = A/P = 7.32 / 10.83 = 0.68$$

Entrance & exit losses  $\approx 1.10 \therefore \text{Tot } k = 1.35$   
 $1.35 = \frac{1}{c^2} \quad 1.35c^2 = 1 \quad c^2 = 0.74 \quad c = 0.86$

Q capacity @ 281' MSL:

$$Q = (0.86)(7.32)(\sqrt{2(32.2 \times 12)})$$

$$Q = \underline{\underline{175 \text{ cfs}}}$$

APPENDIX E  
INFORMATION AS  
CONTAINED IN THE NATIONAL  
INVENTORY OF DAMS



# INVENTORY OF DAMS IN THE UNITED STATES

STATE	DIVISION	CONTRACT	COUNTY	CITY	NAME	LATITUDE NORTH	LONGITUDE WEST	REPORT DATE
NH	232	NED	01	01	UNION LAKE DAM	4311.3	7101.5	18AUG78

POPULAR NAME	NAME OF IMPONMENT
	UNION LAKE

REGION BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	DIST FROM DAM (MI.)	POPULATION
01 04	BELLAMY RIVER	DOVER	11	20850

TYPE OF DAM	YEAR COMPLETED	PURPOSES	SURFACE AREA (ACRES)	HYDRAULIC HEIGHT (FT.)	IMPONING CAPACITIES (ACRES-FT.)	DIST OWN	FED	N	N	N	VER/DATE
RLPG	1890	R	19	17	2400	2000	NED	N	N	N	15AUG78

REMARKS

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NH WATER RES BD	NHMRB	NHMRB	NHMRB

OWNER	ENGINEERING BY	CONSTRUCTION BY
GAIL P. CHASE		

INSPECTION BY	INSPECTION DATE	AUTHORITY FOR INSPECTION
ANDERSON-NICHOLS & COMPANY INC	13JUN78	P.L. 92-367

REMARKS

**END**

**FILMED**

8-85

**DTIC**